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December, 1940

Heating · Piping and Air Conditioning

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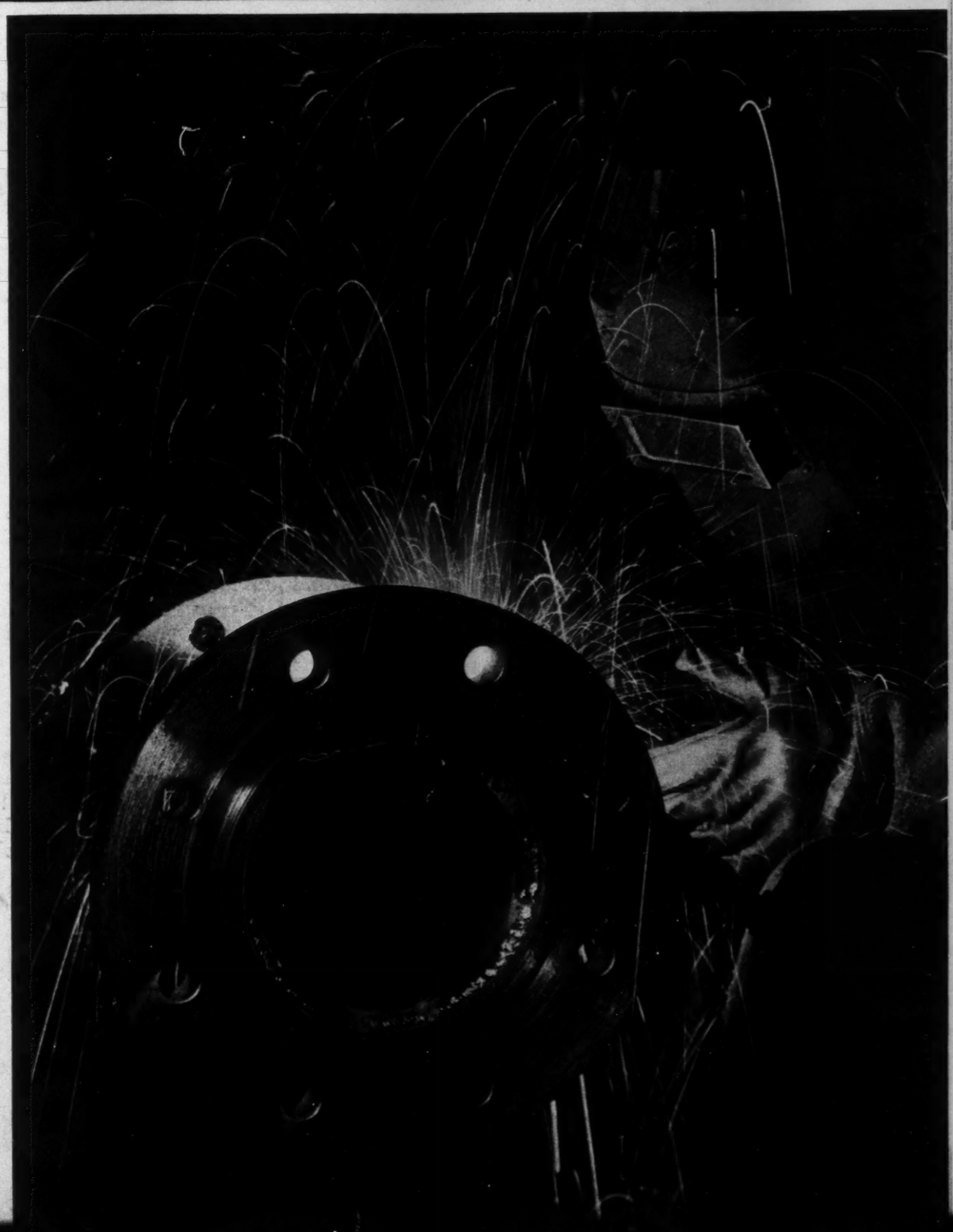

Page 723
Journal Section
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★ Johnson room type "humidostats," as illustrated, (and also those of the insertion pattern to sense humidity in ducts) are provided with any one of a number of different types of elements to fit each particular application.

They're as Different as Your
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"LOOK AT THE WHOLE SYSTEM" is the *Johnson* thought behind the selection of exactly the proper type of "humidostat" for each individual humidity control installation. In solving automatic temperature and air conditioning control problems, always in the minds of *Johnson* engineers is the indisputable fact that even the most efficient devices are valuable only when they function perfectly as part of the whole . . . Almost every installation differs as to the relative humidity to be maintained and the dry-bulb temperature with which that humidity is associated. Various materials, which respond dependably to changes in the moisture content of the surrounding air, are affected differently under each set of conditions. That is why *Johnson* offers "humidostats" with any one of several types of elements, such as animal membrane, human hair, wood in various forms, and other substances . . . Ask for bulletins describing *Johnson* room and insertion type "humidostats." There is no obligation. A post card will bring them. JOHNSON SERVICE COMPANY, Milwaukee, Wis., and Direct Branches in Principal Cities.

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Automatic TEMPERATURE AND AIR CONDITIONING *Control*

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in Industry and Large Buildings**

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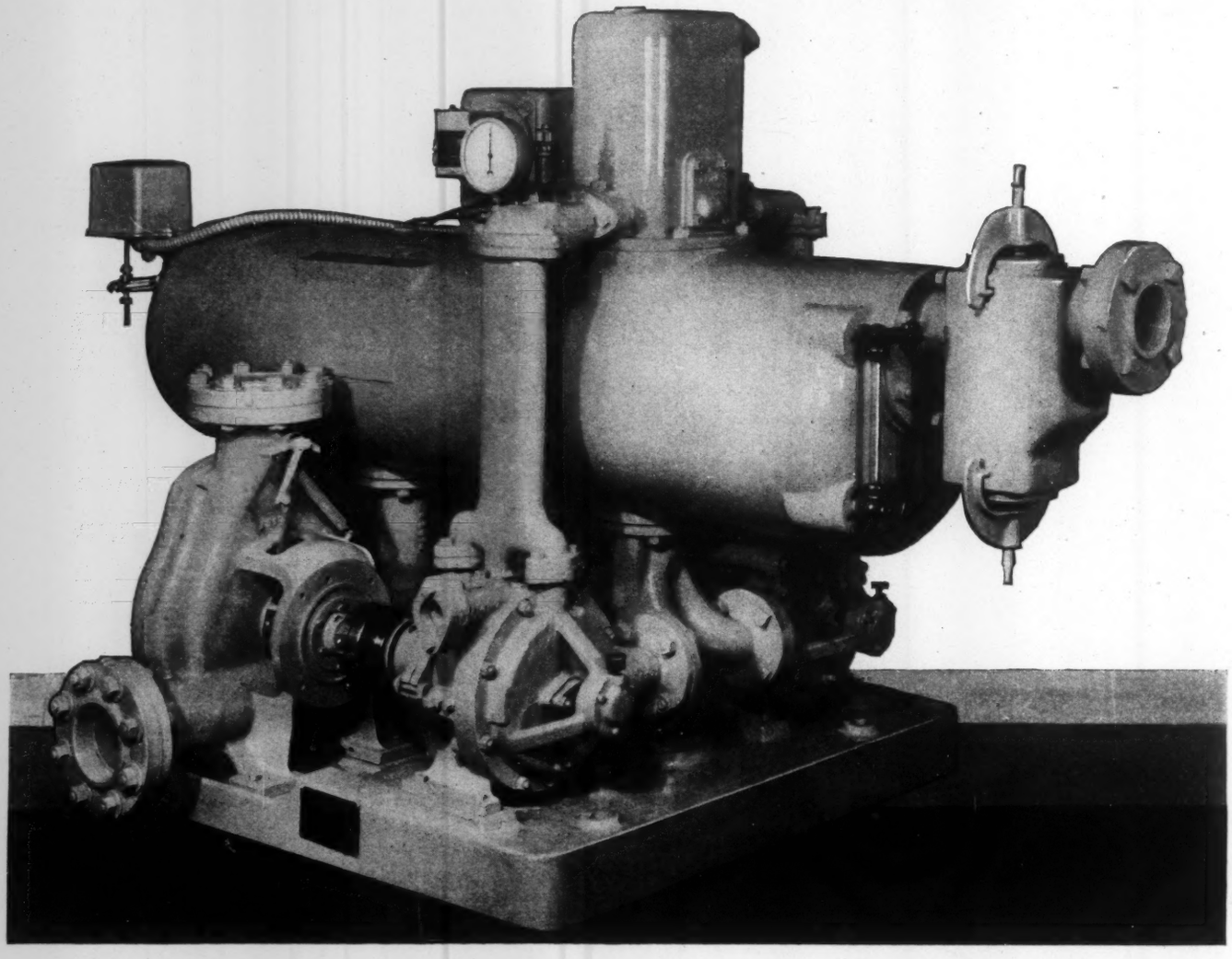
Where heat must *Not* fail . . . install this SAFE *Heating Pump*



In Hospitals, Greenhouses, Schools, Public Buildings, Theatres, wherever heating systems must not fail, install the Nash Vapor Turbine, for it is independent of electric current failure, and continues to operate as long as there is steam in the system. This is because the prime motive power of this economical pump is a special steam turbine, controlled by a unique "Vapor Turbine Valve", which automatically by-passes from the heating main a small portion of steam, the exact amount necessary to develop the power needed to remove the condensate and maintain the required vacuum on the system. Even this small amount is passed immediately back to the mains, and goes on to the system with little heat loss. This pump operates on any system, high or low pressure. The Vapor Turbine is a most economical pump, for the elimination of electric current does away with current cost, the largest single item in the operation of an ordinary return line heating pump.

BULLETIN ON REQUEST

THE NASH ENGINEERING COMPANY
221-A WILSON ROAD, SOUTH NORWALK, CONNECTICUT

THE EDITOR'S PAGES

AIR CONDITIONING MARKET BARELY SCRATCHED

Dr. Willis H. Carrier, chairman of the board of Carrier Corp., believes that the potential market for air conditioning "barely has been scratched," and that the outlook for the air conditioning industry is more encouraging today than ever before. The air conditioning market of the future, he says, lies in the equipment of a multitude of small business places, shops, restaurants, hotels, and apartment houses throughout the country.

Dr. Carrier points out that only 5.46 per cent of the nation's office buildings, 0.3 per cent of the apartment houses and 13.9 per cent of the hotels have been air conditioned up to now. At the start of this year, air conditioning had been installed in 3010 industrial plants, but this amounted to only 1.78 per cent of the nation's 169,111 factories. At the same time, 40,247 installations had been made in commercial markets, or a total of only 2.8 per cent of the saturation point in that field, according to Dr. Carrier. Tobacco factories are the most completely air conditioned of all plants in the industrial market, 23.5 per cent having air conditioning. Second in the industrial field are candy factories, with 10.81 per cent of the total. Fur storage plants place third with 5.63 but in no other fields has even 1 per cent of the saturation point been reached.

Even among theaters, only one out of every six throughout the country are air conditioned. Furthermore, less than one out of every five department stores have been air conditioned, in spite of the fact that, together with theaters, they have reached the highest saturation point among all commercial markets. Only 1.38 per cent of the total number of drug stores have been air conditioned, only 1.8 per cent of restaurants, 2.69 per cent of the banks and 2.21 per cent of all other likely retail stores.

"In office buildings we believe a great expansion of our market is about to take place," according to Dr. Carrier. "In industry the economic advantage of air conditioning, as well as its near necessity in precision work, has just been demonstrated. This field should open up considerable opportunity in the near future as a result of industrial expansion."

WINDOWLESS PLANT FOR DEFENSE WORK

W. E. Barnum, manager of the air conditioning division of York Ice Machinery Corp., announced last month that the Ford Motor Co. has awarded York a contract for four complete refrigerating units in its huge new aircraft engine plant.

Plans for the new Ford plant were made public several weeks ago. It will be devoted exclusively to the precision-manufacturing of Pratt and Whitney aircraft motors. In line with modern defense trends the plant will be windowless and completely air conditioned, permitting manufacturing operations to continue without interruption during "black-outs," according to Mr. Barnum.

This is said to be the largest in-

INTEREST IN RADIANT HEATING

Radiant heating or panel warming (there is as yet little agreement on what term should be used for this method) is not new, although its greatest use has been in England and in Europe rather than the United States. However, in recent months there apparently has been a tremendous increase in the interest of architects, engineers and contractors in the subject. There have been several recent installations, and—judging from requests we have received for data on radiant heating—many others are contemplated. HEATING, PIPING AND AIR CONDITIONING has devoted quite a number of pages to discussion and explanation of radiant heating principles and systems. The following brief listing of radiant heating or panel warming articles which have been published in these pages is given here for the convenience of those who want to refer to such data:

We concluded in our October, 1940, issue the series of five articles by F. E. Giesecke on radiant heating and cooling, the first of which appeared in June. These articles give probably as complete information as is available anywhere on the principles of radiant heating and methods of design.

In our July, 1940, issue, the wall warming system for the Bankers Life building in Des Moines was described. While this is not strictly a radiant heating system, it has coils in the walls to take care of wall losses. In May, 1940, Erwin L. Weber described a panel warming and cooling system for a school building. In March, 1940, the panel heating for the air ministry headquarters building in London was pictured; a drawing and supplementary description gave further information on this in June. In February, 1940, Zamenhof reviewed some foreign experiences with radiant heating.

Victor Walters described the floor coil heating system for the Johnson Wax air conditioned building at Racine, Wis., in the November, 1939, HPAC. A preliminary article on this same building appeared in April, 1938.

In the December, 1938, HEATING, PIPING AND AIR CONDITIONING Drs. C. A. Mills and John Gorrell described a radiant cooling installation for a hospital operating room, and in July, 1938, T. Napier Adlam described the underfloor heating system for an English cathedral.

In July, 1937, Leon L. Munier wrote on American practice in panel heating.

In the ASHVE Journal Section, which appears each month in HEATING, PIPING AND AIR CONDITIONING there have appeared the following papers: Control of Body Heat Loss Through Radiant Means, by C. A. Mills and Cordelia Ogle, November, 1937; Room Warming by Radiation, by Arthur H. Barker, March, 1932; Panel Warming, by L. J. Fowler, January, 1930.

A most unusual panel warming system is described in an article by Erwin L. Weber this month—a service garage in Klamath Falls, Ore. The garage portion is heated by pipe coils in the floor, and the office portion by coils in the suspended ceiling. Warm well water is available for the heating job at this particular locality.

To continue to meet the demand for information on this subject, HPAC has scheduled several more such articles for the 1941 issues.

dustrial air conditioning contract ever awarded as a single installation. Four 1000 ton turbo-compressor water cooling systems will supply the refrigerating effect.

AMERICAN AIR FILTER NOT SOLD

The American Air Filter Co. announced last month that reports of its purchase by a large electrical manufacturing company were premature. Negotiations which never advanced beyond the preliminary stage have been definitely abandoned by mutual consent of both companies, says J. R. McConnell, vice-president. There has been no change in ownership, management or field representation of the American Air Filter Co., which will continue to function as an entirely independent organization, he states.

PROMOTE ALL-INDUSTRY SHOW

In launching its attendance promotion campaign for the third annual "All-Industry" refrigeration and air conditioning exhibition at the Stevens Hotel, Chicago, January 13-16, the exhibition committee, according to Chairman M. W. Knight, general sales manager of Peerless of America, Inc., has sent full details and an invitation directly to the members of the trade who are expected to attend. Members of the trade will receive or can obtain official admission cards from exhibitors.

Heading the list of meetings being held in conjunction with the show is a conference on sales problems to be conducted by the American Society of Refrigerating Engineers, the annual convention of the Refrigeration Service Engineers Society, and the annual meeting of the National Refrigeration Supply Jobbers Association. Also on the docket during the week is a luncheon meeting of the Refrigeration Equipment Manufacturers Association.

IT AIN'T FAIR

A contemporary—one of the oil heating magazines—recently published an article on humidification of homes, the general object of which was to simplify air conditioning terminology; air conditioning "is more shackled and waterlogged with 16 cylinder words than any [other] known industry," according to this article.

Phrases like "dehumidification of atmospheric infiltrations" and "atmosphere at 0 F will absorb a maximum of 437.5 grains of *aqua pura* per cfm [*sic*]" were set up by the article's author as horrible [and inaccurate] examples, and then rephrased in every day words to show how unnecessarily complicated the air conditioning vocabulary is to the public.

We'll admit that many of the terms and phrases used in air conditioning may be unintelligible to the uninitiated. But it just ain't fair to air conditioning to set up formidable "straw men" like the above merely to knock them over by simplifying them. We're sure that air conditioning engineers say "water" instead of *"aqua pura,"* just like people do.

NEW RESEARCH ON COAL

Bituminous Coal Research, Inc., the research agency of the bituminous coal industry sponsored by the National Coal Association, announced last month the inauguration of a $200,000 program of research aimed to advance the competitive position of coal by the development of better equipment for its use in industry and homes. Following the plan adopted in the previous 3½ year program of the corporation, Howard N. Eavenson, president, has completed arrangements with Clyde E. Williams, director, Battelle Memorial Institute, to carry on the program at Battelle.

The broad program of research will include studies of methods by which close control of heating and smokeless operation may be combined with the natural advantage of coal as a low cost source of energy. The direct application of coal as a fuel for metallurgical and ceramic furnaces, methods for the complete gasification of coal for industrial and residential use, and the direct conversion to mechanical energy through the use of coal in a new type of internal combustion engine are among the problems to be attacked as developed by the research program committee.

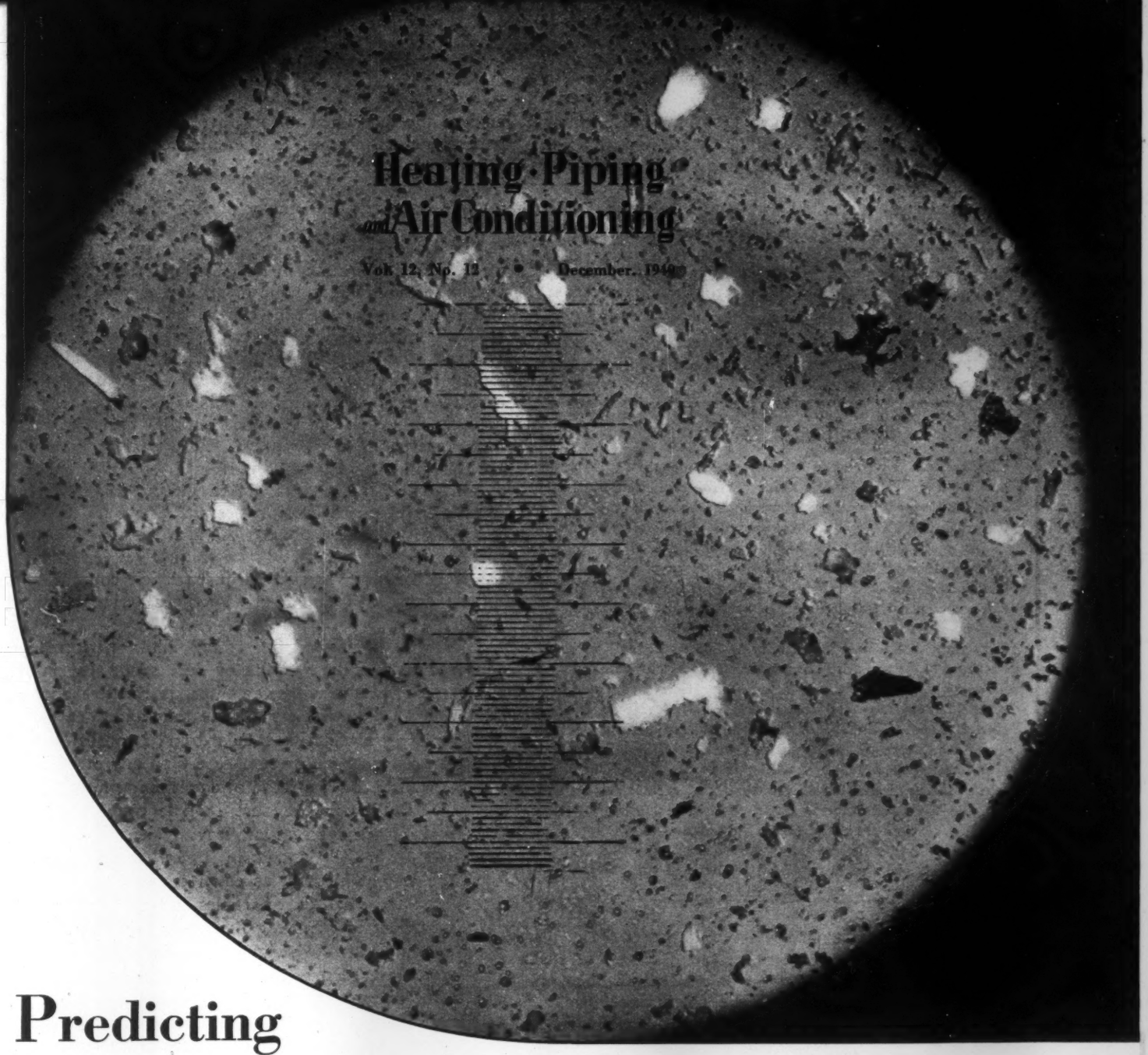
STOKER SALES GO UP

Factory sales of mechanical coal stokers of all sizes and types showed an increase of slightly over 50 per cent for the first nine months of this year as compared to the same period in 1939, and 65½ per cent increase in sales over the corresponding month of 1938, according to figures released by the U. S. Department of Commerce based on reports supplied to the government by 107 stoker manufacturers, according to the Committee of Ten.

THESE MOSQUITOES CAN BITE

Each of two new torpedo boats, the PT3 and PT4, built by the Fisher Boat Works of Detroit, are equipped with three direct connected blowers to vitalize the air for the crew of eight and to remove odors, cooking fumes, etc. The motor on each blower is mounted on the wheel to avoid friction and noise and to save space and weight. Tests on the Detroit River indicate that these new members of the "mosquito fleet" attain speeds of 40 knots. Each boat is fitted with two machine gun mountings, is designed to fire two torpedoes at one time and is powered by two 1200 hp motors. Costing $100,000 apiece, the boats will combine with two similar craft being built in Miami and four others constructed in New Orleans and Philadelphia to form an experimental fleet covered by the $15,000,000 appropriation for development of torpedo boats and sub chasers

Photo courtesy Ilg Electric Ventilating Co.



Predicting DUST CONCENTRATION

Factors Affecting Dust Concentration Levels in Enclosed Spaces . . . . . By Frank B. Rowley* and Richard C. Jordan†

[Shown above—Air borne dust particles magnified 1000 times]

ALTHOUGH much has been done toward the determination of the dust eliminating efficiencies of filters for air conditioning systems, no quantitative methods of analysis have been developed for determining the degree to which the use of these filters will actually lower the dust concentrations in enclosed spaces. The rates at which dust laden outdoor air is introduced into the space, with which dust is produced in the space and with which dust settles from the air, and the rate at which the air is filtered, are usually of greater importance in the determination of the actual dust concentrations than the efficiencies of the filters themselves. Filters of low efficiency may in time reduce the dust concentration in a building to a very low value if little dust is produced in, or introduced from the outside into,

*Director, Engineering Experiment Station, Institute of Technology, University of Minnesota. Member of HPAC's Board of Consulting and Contributing Editors.
†Instructor, Engineering Experiment Station, Institute of Technology, University of Minnesota.

the conditioned space. On the other hand, filters may have efficiency ratings approaching 100 per cent, but the dust concentration within the building still may be above that of the outdoor air if the rate of filtering is low and dust is produced inside the space at a high rate. All of these factors must be considered and evaluated if an accurate estimate of the actual interior dust level is to be made.

In many instances little consideration is given to the relative effects of these factors in the design of air filtration systems for industrial, commercial or residential installations. For example, in the majority of residential winter air conditioning systems the filtration of air is secondary to and dependent upon the heating process. The filtration of air takes place only when the blower is operating to supply heat to the conditioned spaces. As a result, during periods of mild weather when little heating is necessary, the average inside dust concentration level runs comparatively high. The application of modulated control to the rates of air circulation and heat input to the system will tend to rectify this condition, but as yet such systems are in the minority.

SUMMARY

The authors have made studies on atmospheric dust and methods of measuring it for several years, but until now nothing of a semi-popular nature about the various factors involved, or the developments which have been taking place in this field, has been published. It is the authors' feeling that the question of atmospheric dust has been more or less neglected insofar as methods of measurement or standards are concerned—yet it is most important in many air conditioning problems, particularly now that industrial activity is increasing and will continue to do so under the requirements of our national defense program. . . . . This month's article is devoted to the factors affecting dust concentration levels in enclosed spaces. The rates at which dust laden air is introduced into the space, with which dust is produced in the space and with which dust settles from the air, and the rate at which air is filtered, are usually of greater importance in the determination of actual dust concentrations than the efficiencies of the filters themselves. The theory upon which this discussion is based was proposed by Dr. Jordan, and was worked out by both of the authors

When air filtering systems are designed primarily for the elimination of air borne pollens as an aid to the alleviation of hay fever and other allergic diseases, their effectiveness is readily determined under practical conditions. In some instances such systems operate satisfactorily, while in others little relief is experienced. In many of these unsatisfactory installations efficient air filters have been installed, but further analysis shows the rest of the design to be inadequate and the resulting pollen concentrations to be too high for satisfactory relief.

Other examples of inadequate dust control in industrial, commercial and residential structures verify the need for a method of analysis which will permit the prediction of interior dust concentration levels in relation to the prevailing exterior levels and which will provide a method for determining the relative efficacy of the different means used for dust control. However, before any relationships can be derived, it is first necessary to analyze the individual factors involved, both as to their general nature and as to the methods by which they may be evaluated.

Rate and Efficiency of Air Filtration

The rate of air filtration, which is easily evaluated, is of great importance in its effect upon the final dust concentration. The volume of air to be passed through the filters per unit of time can be calculated readily by standard methods of duct design. However, it should be kept in mind that the original rate of air filtration is not necessarily the average rate of filtration under actual operating conditions. This is especially true for systems in which the resistance of the filters forms a comparatively high percentage of the total resistance of the system. In such cases there are sometimes marked reductions in the rate of air circulation caused by an increasing pressure drop across the filters as they remove the dust and lint from the air.

The efficiency of air filtration may be based upon the weight of dust in air, the dust particle count, or the optical density of the dust, sometimes termed "soiling power."

The weight method of rating filter performance, which measures the weights of dust suspended in the air entering and leaving the filter, is the one adopted by the American Society of Heating and Ventilating Engineers[1] as a tentative standard and is probably used more generally at the present time than any other.

The particle count method of determining filter arrestance is based upon the dust particle count per cubic foot of air on the entering and leaving sides of the filter.[2] This method usually results in somewhat lower ratings than the weight method, as equal emphasis is given to both large and small dust particles and the average filter is less efficient in removing the small particles than the large ones. With the weight method a few large particles, which are comparatively easily removed, may constitute the majority of the weight of dust in the air.

The "soiling power" method of efficiency determination is based upon the optical densities of filtering papers through which samples of the air-dust mixture upstream and downstream of the filter have been passed. The optical densities are determined by means of a light beam on one side of the paper and a photo-electric cell on the other.[3]

A quantitative analysis of the dust concentrations in enclosed spaces can be based upon either particle count or weight and probably could be based upon soiling power if units of measure involving the relative soiling power per unit volume of air were introduced. Filtration efficiencies determined by any of the three methods discussed are obtainable for application to a quantitative analysis of this type. Although the derivations to be presented have been placed on a particle count basis, the equations given can be translated readily to a weight basis.

---

[1]ASHVE Standard Code for Testing and Rating Air Cleaning Devices Used in General Ventilating Work. Transactions, American Society of Heating and Ventilating Engineers, Vol. 39 (1933), pp. 225-236.

[2]The Dust Problem in Air Conditioning, by F. B. Rowley, ASHVE Journal Section, HEATING, PIPING AND AIR CONDITIONING, Vol. 7, No. 6 (June, 1935), p. 298.

[3]A Test Method for Air Filters, by Richard S. Dill, ASHVE Journal Section, HEATING, PIPING AND AIR CONDITIONING, Vol. 10, No. 8 (August, 1938), p. 550.

Infiltration and Exfiltration

All structures are subjected to a displacement of the interior air because of wind pressure and the difference in densities between the inside and the outside air. The movement of this air takes place principally through the cracks around the doors and windows and any other openings which may be present. The effect of this air movement is to raise the interior dust concentrations when the exterior concentration is the higher and to lower it when the interior concentration is the higher. In an air conditioned space the former case is the usual one, with the interior dust level higher than the exterior only where there is an interior source of dust with a relatively higher rate of production.

The rates and volume of air leakage into and from enclosed spaces have been given comprehensive study, and the factors and procedures to be used in their evaluation are thoroughly outlined in the American Society of Heating and Ventilating Engineers' Guide.[4] In the case of window and door crackage, the greatest sources of infiltration and exfiltration in the average structure, the factors to be evaluated are the type of construction, the lineal feet of crackage and the design wind velocity. In the case of dust control problems the design wind velocity should be approximated as the average wind velocity over the period of time in question, which information can be obtained from weather bureau records.

Internal Dust Sources

One of the most difficult factors to evaluate practically is the rate of production of dust in the interior space being analyzed. Fortunately, however, this is a factor which is involved to appreciable extents only in certain specific problems and is relatively unimportant in most commercial and residential air conditioning installations designed for maintenance of comfort and health conditions. The only usual interior source of dust in such installations is the settled dust which is disturbed from the floor and furnishings and thereby again suspended in the air. Ordinarily these dusts are probably not raised high enough but that they will again soon settle out of the air unless the disturbance is in the vicinity of convection currents.

In contrast to "comfort and health" air conditioning installations, in industrial dust control problems the rate of internal dust production becomes a dominating factor. In factories where the manufacturing processes introduce large numbers of dust particles into the air, the magnitude of this factor may easily dwarf the majority of the others. The actual rate of production of dust must be determined experimentally. This may be done if the size distribution of the particles produced, the density, and the volume or weight of the material per unit of time involved in the production are determined. However, in many cases, the problem defies complete analysis because of the poor distribution of the produced dust. In many industrial processes an attempt is made to eliminate the dust at its source before widespread distribution takes place. In any case, even though the factor of rate of dust production is approximated with considerable error, further analysis of the dust concentration level will be of value for the purpose of determining the relative efficacy of those means being used to reduce the dust level.

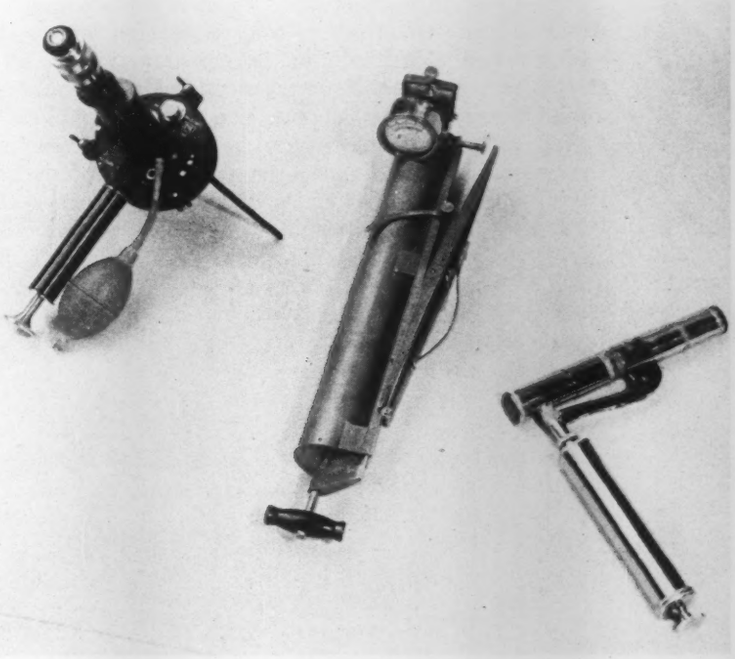
[4]Heating, Ventilating, Air Conditioning Guide, 1940. Chapt. 6, pp. 117-126. American Society of Heating and Ventilating Engineers, New York, N. Y.

Settling of Dust

The amount of dust which will settle from relatively still air per unit of time depends upon the concentrations of the different sizes of particles and their respective velocities of fall. The velocity of fall, according to Stokes' Law, varies directly as the square of the diameter of the particle and as the difference in densities between the particle and the suspending medium. Therefore, the magnitude of the factor involving the rate of settling will depend largely upon the range and relative frequencies of the various sizes of particles involved. If the analysis is being made on a weight basis, the large, fast-settling particles will be the determining factor in spite of their infrequency. If we consider spherical particles of equal density, a 10 micron diameter particle will have 1000 times the weight of a one micron diameter particle and will settle with a velocity approximately 100 times as fast. Thus, the rate of settling will become a dominant factor in determining dust concentration levels on a weight per cubic foot basis.

Although they are more conspicuous except under microscopic examination, these large air-borne dust particles actually are relatively few in number. The vast majority of particles are small in diameter and comparatively slow in settling. Thus, the rate of settling of dust will become a comparatively unimportant factor when we consider dust concentration levels on a particle count per cubic foot basis.

The following analysis of the rate of settling factor for dust is considered first from the standpoint of a single particle size with a single velocity of fall, and second, from the standpoint of different ranges and fre-



Typical dust counters for determining atmospheric dust concentrations

quencies of particle sizes with varying velocities of fall. Let

V = volume of room, cu ft;
v = velocity of fall of dust particles, fpm;
A = floor area of room, sq ft;
H = height of room, ft;
C = dust concentration, particles per cu ft.

Then CV = total number of dust particles in room,
and $V = AH$ for all rooms of average design.

If we assume still air conditions, the time required for a column of air to be cleared of all of its dust by settling will be equal to the height of this column divided by the velocity of settling. Therefore,

$$\left.\begin{matrix}\text{Number of particles}\\ \text{settling per minute}\end{matrix}\right\} = CV\frac{v}{H} = CAv$$

and

$$\left.\begin{matrix}\text{Number of particles settling}\\ \text{per minute per cubic foot}\end{matrix}\right\} = \frac{CAv}{V} = C\frac{v}{H} \quad \ldots [1]$$

This analysis assumes still air and a uniform size, density and shape for all particles within the enclosed space. Furthermore, it assumes that there is a constant dust supply in or to the room so that the dust will not eventually all settle from the air. Practically, the latter condition is approximated by the dust supplied by infiltration, ventilation air and internal dust sources. The continual changing of the air-dust mixture will tend to maintain the dust concentration constant from point to point in the room; whereas, theoretically, still air conditions coupled with no dust sources would result in vertical size and concentration gradients in the case of dust particles of varying size. In the case of dust particles of one size, shape and density, and with still air conditions, there would be a constantly lowering horizontal plane of demarcation with dust below and no dust above. Practically, however, still air conditions are never attained, and the air movement normally encountered in rooms is probably sufficient to maintain a reasonably good distribution of the dust as well as to modify the theoretical velocities of settling of the particles as calculated by Stokes' Law.

In order to evaluate Equation 1 when there is a variation in size of the dust particles, it is first necessary to determine an "effective" velocity of settling for the dust which, when substituted in the equation, will result in the correct number of particles settled per minute per cubic foot regardless of the size variation. Such an "effective" settling velocity can be obtained by weighting the velocities according to the percentages of particles having the various velocities of fall. If Equation 1 is used and it is assumed that every cubic foot of air in the space in question contains a number of different sizes of particles with different settling velocities, the number of particles settling per minute will be the summation of the terms

$$C_1\frac{v_1}{H} + C_2\frac{v_2}{H} + \ldots\ldots\ldots\ldots\ldots\ldots + C_n\frac{v_n}{H}$$

where the subscripts 1, 2, ..., n indicate definite size increments of dust particles. Since

$$C = C_1 + C_2 + C_3 + \ldots\ldots\ldots\ldots\ldots\ldots + C_n$$

then the "effective" velocity of fall, v_{eff}, may be introduced and

$$C\frac{v_{eff}}{H} = C_1\frac{v_1}{H} + C_2\frac{v_2}{H} + \ldots\ldots\ldots\ldots + C_n\frac{v_n}{H}$$

or

$$v_{eff} = \frac{C_1}{C}v_1 + \frac{C_2}{C}v_2 + \ldots\ldots\ldots\ldots\ldots + \frac{C_n}{C}v_n$$

where

$$\frac{C_1}{C}, \frac{C_2}{C}, \ldots\ldots\ldots\ldots \frac{C_n}{C}$$

represent the percentages of the total number of particles contained within any one size range. Thus, the "effective" velocity of fall is equal to the summation of the individual velocities of fall weighted according to percentage by number, or

$$v_{eff} = \sum_{m=1}^{m=n}\frac{F_m v_m}{100} \quad \ldots\ldots\ldots\ldots\ldots\ldots [2]$$

where v_{eff} = effective velocity of fall for all particles, fpm;
F = frequency by number for one size range of particles, per cent;
v = velocity of fall for one size range of particles, fpm;
m = 1, 2, 3, . . . n and indicates the various dust particle size ranges assumed.

Combining Equations 1 and 2

$$\left.\begin{matrix}\text{Particles settling per}\\ \text{minute per cubic foot}\end{matrix}\right\} = \frac{C}{100\,H}\sum_{m=1}^{m=n}F_m v_m \ldots [3]$$

This equation has been derived on the assumption that all particles of the same size have the same velocity of fall. If the particles vary in density and shape, this does not hold true, and it is then necessary to group them further as to density, shape and size.

There are at least two factors in practice which will tend to modify the theoretically calculated "effective" velocity of fall. First, the dust suspension will probably have a vertical gradient both as to particle size and concentration, as previously explained; this probably will be offset for the most part by convection currents. Second, for at least those filters based on mechanical principles of dust elimination, there will be a selective filtering in favor of the larger dust particles. This will tend to reduce the average size of the dust particles in suspension and thus tend to reduce the "effective" velocity of settling.

In the prediction of dust concentrations in enclosed spaces, the rate of settling factor can be evaluated theoretically by means of Equation 3, Stokes' Law and data concerning the size frequency distribution of the dust involved. Practically, such factors as the shape of the particle and the effects of air currents modify the theoretical results, and greater accuracy could be obtained by determining the rate of settling experimentally. If the analysis is to be made on a weight basis and is thus concerned mainly with the large dust particles, errors in the assumptions affecting the rate of settling may result in considerable error in the value of the final dust concentration level, since this factor is then a dominant one. However, if the analysis is to be made by particle count and the distribution is predominantly one of small particles (such as in the case of normal air), the "rate of settling" factor has only a slight effect upon the value of the final dust concentration, and errors in the assumptions affecting this factor are of relatively small importance.

[*Future articles on this subject will cover continuous and intermittent filtering processes, and will give typical examples of dust concentration analyses.*]

New Technique Developed for

INSULATING COLD FLUID PIPING

E. T. Cope and W. F. Kinney of Detroit Edison Research Staff Describe Use of Latex Rubber as Vapor Barrier

SUMMARY—A new technique, in the development of which the authors played the major part, for the use of sprayed latex emulsion for producing a vapor barrier on the outside surface of the insulation on cold fluid piping is described here, as is its application to two 10 in. pipe lines conveying cold water. . . . Of value in the fields of low temperature piping, refrigeration and air conditioning, the method was perfected because of failure of a commonly used type of vapor barrier at several points on the anti-sweat insulation of earlier installations. In one case, water vapor that had entered the covering around pipe hangers on a vertical length of piping on an upper floor had appeared as moisture at an elbow at the lower end of the pipe in the basement of the building and saturated the insulation. In other instances, water vapor had entered around valve stems, under defective joints in the cotton sheeting on the insulation on elbows and tees, and at other places where the existence of flaws was not suspected. With the new method, no evidence of the penetration of water vapor into the covering has been found after a season's operation

FAILURE of a commonly used type of vapor barrier at several points on the anti-sweat insulation of chilled water piping in earlier air conditioning installations in The Detroit Edison Co. office buildings made it necessary to replace some of the insulation. In one case, water vapor that had entered the covering around pipe hangers on a vertical length of piping, at an upper floor, had actually appeared as moisture at an elbow at the lower end of the pipe in the basement of the building and saturated the insulation. In other instances, water vapor had entered around valve stems, under defective joints in the cotton sheeting on the insulation on elbows and tees, and at other places where the existence of flaws was not suspected. These installations had been assembled by reliable pipe coverers using current and accepted methods of installation. Therefore, when the extension of air conditioning services in the company's older main office building was being considered, engineers in the company thought that the technique for sealing the insulation on chilled fluid piping should be reviewed and improved, if possible, by the development of an effective vapor barrier.

Proposed Installation

The air conditioning of the company's main office building involved the laying of chilled water piping between it and the company's newly completed office building nearby.[1] As an underground concourse connected the two buildings, it was decided to place the piping in it rather than go to the expense of constructing a separate underground duct.

The installation was to consist of two 10 in. pipes, one a supply and one a return line, each about 500 ft long, of which about 300 ft of each line was to be placed inside the concourse and the remainder in the basements of the buildings. The center line of each pipe when erected was to be 8½ in. below the ceiling and 8½ in. away from the wall of the concourse. With 1½ in. thickness of covering installed, the clearance between the covering and the ceiling and between the covering and the nearby wall would become 1¾ in.

Such rigid space requirements imposed strict limitations on the design, assembly and maintenance of the piping and its anti-sweat insulation. Because the piping was to be an all-welded structure, practically the entire 300 ft of each piping as-

[1]This building was described in Air Conditioning Influences Building Design, by J. H. Walker, HEATING, PIPING AND AIR CONDITIONING, October, 1937.

Fig. 1—Vapor seal at butt joints of insulation

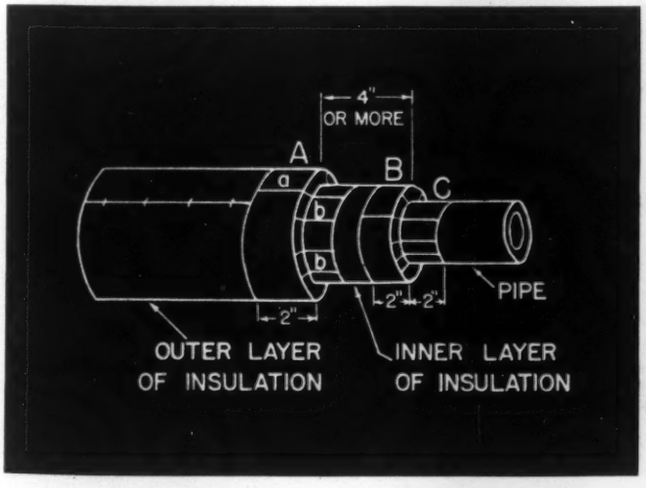


Fig. 2—Sealing of butt ends of the insulation at a valve

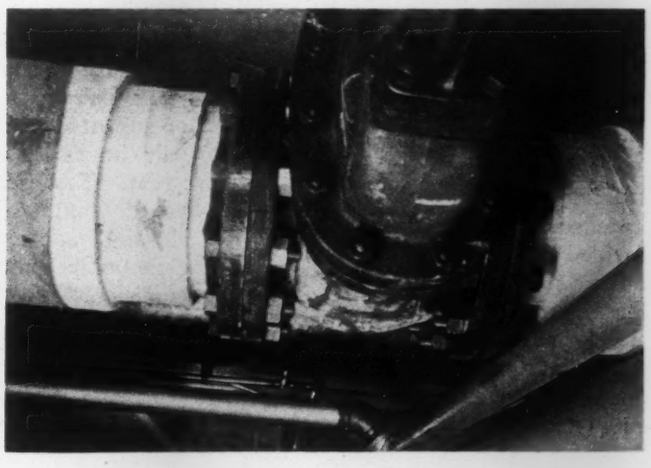


Fig. 3—First coating of latex impregnated sheeting on valve installation

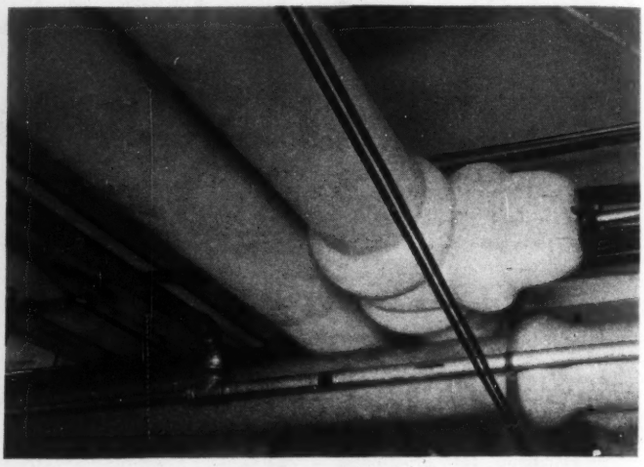


Fig. 4—Completed insulation on valve and pipe

sembly within the concourse had to be assembled, covered with insulation and vapor sealed while the assembly was resting near the floor on trestles. No failure of any part could be tolerated during the life of the structure as there would be no room in which to make repairs when the piping was in place. Besides these conditions, the anti-sweat covering and its vapor barrier had to be moderate in cost, which precluded the use of elaborate methods of assembly and of any but the less expensive materials. Finally, the exterior surface of the covering had to be finished to conform in color to the interior of the concourse.

Development of Vapor Barrier

Heretofore, oil-base paint had been relied on as a vapor barrier and surface finish on canvas jackets. However, experience extending over several years had shown that it was not satisfactory unless applied thoroughly on cotton sheeting of 6 oz weight or over, and even then it had to be renewed periodically in order to seal the checks that eventually appear in all such painted surfaces. This condition excluded the use of an oil-base paint alone because a quarter of the outside surface of the covering could not be reached for repainting after the piping had been installed. In consequence, it was decided to depart completely from former practices—at least as far as the vapor barrier was concerned—and to try something new.

Previous experience with emulsified latex as a waterproofing film suggested the use of this type of material for producing a vapor barrier. A search for published data on the performance of latex emulsions containing self-vulcanizing agents when spread into a thin membrane or when applied on the surface of cotton sheeting and exposed to atmospheric air for several years did not reveal definite information. Discussions with chemists and rubber technicians added little positive reassurance to the hope that latex emulsions might prove to be satisfactory. Consequently, a program of tests was carried out to determine the probable effect of exposing thin films of latex to air as indicated by accelerated aging in the Bierer-Davis oxygen bomb.[2] Rubber technicians have stated that 250 hr of the oxygen bomb test duplicates the effect of 15 to 20 years' exposure to indoor air at normal temperature. At the same time, the probable effect on the latex of oil-base paint, of amyl-acetate lacquer, of casein paint, and of one brand of cold water paint was investigated in order to find a surface finish that would provide a suitable color and at the same time would not adversely affect the latex.

In all of these tests, the change in tensile breaking strength of the latex film was used as an indication of any deterioration that might impair its effectiveness as a sealing agent. Test specimens were prepared from strips of 6 oz cotton sheeting appropriately folded and thoroughly saturated with latex emulsion. When dry, some of the specimens were painted with the various surface finishes. The tensile breaking strength of the latex film was determined, before and after subjecting the specimens to the oxygen bomb test, by separating the folds in a fabric testing machine. The results of these tests are summarized as follows:

1) The oxygen bomb test produced considerable loss of tensile breaking strength of unpainted latex but sufficient strength remained so that the material still adhered well to the fabric and appeared to be satisfactory.

2) Oil-base paint, amyl-acetate lacquer, and casein paint applied to the surface of the latex caused a complete loss of tensile breaking strength.

3) The brand of cold water paint used in the tests appeared to protect the latex film from the deteriorating effect of the oxygen, as the loss of tensile breaking strength of latex painted with this finish was appreciably less than that of unpainted latex that had been subjected to the same treatment in the bomb.

Supplementary tests showed that cotton sheeting thoroughly saturated with latex emulsion and allowed to dry was impervious to water. Other trials showed that the emulsion could be readily spread onto cotton sheeting by means of an ordinary paint spray gun. The only precaution necessary was that the spray gun have no copper or manganese bearing parts that might come into contact with and contaminate the latex emulsion. The results of these tests were so encouraging that this material was put to use at once.

Design of Pipe Supports

There was yet one unsolved problem: How was the piping to be supported from the roof of the concourse without puncturing the vapor barrier or injuring the insula-

[2]This oxygen bomb test is described in American Society for Testing Materials Designation B42S-36T.

tion and vapor barrier after they had already been applied? There were obvious objections to puncturing the vapor barrier to admit supports attached to the pipe. Instead, it was decided to use saddles, spaced at appropriate intervals on the outside of the insulation. The results of tests showed that 12 in. long saddles made from ⅛ in. steel plate bent to fit halfway around the outside of the insulation and having the edges rounded, would not deform the insulation noticeably and would not damage the latex film or the 6 oz. cotton jacketing, while supporting the pipe at 20 ft intervals.

Assembly and Erection

The problem of supporting the piping was satisfactorily solved and erection was started. The sections of pipe, having the ends beveled ready for welding, were placed on trestles about 2 ft high along one side of the concourse, in accurate alignment to conform to the shape of the ceiling and wall. The joints were arc welded in the usual manner, making a continuous run of about 300 ft of piping. Hydrostatic pressure tests showed the structure to be watertight.

The piping, still supported on the trestles, was insulated with double layer sectional wool felt covering of 1½ in. total thickness. In assembling the insulation, a thin layer of adhesive cement was applied to all abutting faces and all longitudinal and circumferential joints on the two layers were staggered. The longitudinal joints were stapled together and all joints in the outside layer were pointed using asbestos finishing cement.

After the asbestos insulating cement, used to point the joints, had dried, 6 oz cotton sheeting was stretched over the outside surface of the covering, overlapped about 2 in. at all longitudinal and circumferential joints, and sealed in place, using latex emulsion. The cotton sheeting was then thoroughly saturated with latex emulsion using a paint spray gun. As the application of covering approached each trestle, the weight was transferred to another trestle supporting a saddle beneath the covering already installed.

At intervals of about 30 ft along the pipe, the butt ends of both layers of insulation were sealed to prevent water vapor that might enter the covering through possible accidental flaws in the vapor barrier from migrating for any considerable distance along the pipe. As illustrated in Fig. 1, this was accomplished by the use of strips of 6 oz cotton sheeting about 5 in. wide and long enough to reach around the outside of the covering and overlap at least 2 in. The exposed surfaces near the ends of both layers of covering and of the adjacent pipe were coated with latex emulsion, which was allowed to dry.

One 5 in. strip of cotton sheeting was wrapped tightly around the end of the outer layer at *A*, covering about 2 in. of the insulation, overlapped circumferentially at *a*, and sealed using latex emulsion, forming a tight sleeve. After allowing a few minutes for the latex to set, the entire sleeve was saturated with latex emulsion. While still wet, the loose edge of the sleeve was cut axially back to the butt end of the insulation, in 3 in. wide tabs, which were then fitted to the butt end of the outer layer of insulation and their free ends pressed against the inner layer at *b*. By careful fitting, this made a seal of latex-saturated cotton sheeting over the end of the outer layer. This procedure was repeated at *B*, sealing the inner layer onto the pipe at *C*.

A strip of cotton sheeting about 4 in. wide was then wrapped tightly around the protruding inner layer and saturated with latex emulsion, thus binding down and again sealing the sheeting already in place at *b* and *B*. A similar strip was then wrapped around the pipe at *C* and sealed in place. All the cotton sheeting was then thoroughly saturated with latex emulsion. The butt ends of the insulation adjacent to elbows, valves and fittings were sealed in a similar manner, as shown in Fig. 2.

Irregular shapes in the structure, such as fittings and valves, were insulated using two layers of hair felt, each ¾ in. thick, with the outer layer overlapping the protruding inner layer of the adjacent sectional covering. Each layer was cut to fit and was then tied securely in place with cord. The exposed surface of the outer layer was completely covered with strips of cotton sheeting freshly impregnated with latex emulsion. After drying, which required only a few minutes, a layer of finishing asbestos cement was applied and troweled smooth. After the cement had dried, a 5 in. wide band of 6 oz cotton sheeting was wrapped tightly over each joint between the wool felt on the pipe and the hair felt covering on the fitting and swabbed or sprayed with latex emulsion. The entire outside surface of this insulation was then wrapped with a layer of 6 oz cotton sheeting saturated with latex emulson, overlapped at the edges and carefully fitted to the contour of the insulation on the fitting, as shown in Fig. 3.

Valve stem guides that protruded through the covering were given special treatment. The metal was first thoroughly cleaned to remove oil and grease; then latex-impregnated cotton sheeting was wrapped tightly around the insulated bonnet, covering about ½ in. of metal beyond the insulation. A vapor and water seal was effected at the joint between the protruding metal and the covering on the valve by spraying with latex. Other metal parts that protruded through the covering were treated in a similar manner. The final appearance of an insulated valve is well shown in Fig. 4.

The piping within the concourse was then ready to be lifted to its hangers and fastened in place with anchor bolts inserted at proper locations in the concrete roof. The hangers were made from ½ in. by 6 in. steel plate, bent to accommodate the saddles and covering. Before each saddle was placed against a latex surface its inner face was thoroughly coated with talc. Chain falls, attached to the ceiling of the concourse at the anchor points, were used to lift the piping. Fig. 5 shows the piping on the left hand side raised nearly to the ceiling and supported on the chain falls. The high chairs, shown against the wall on the right, were placed in appropriate positions below the pipe and a screw jack was used to complete the raising. The structure, resting on the screw jacks, is shown at the right of Fig. 6. The piping was raised into position at the ceiling, care being exercised to see that it was level and in proper alignment throughout the operation. One assembly in place is clearly shown at the right in Fig. 5 and on the left in Fig. 6. The final appearance after the cold water paint was applied is shown in Fig. 7.

The remaining portions of both

Fig. 5—Assembled piping supported on chain falls

Fig. 6—Assembled piping on screw jacks ready for raising into place

10 in. lines, not located in the concourse, were situated where the space limitations were, for the most part, much less strict than those which prevailed in the concourse. No great difficulty was experienced in erecting the piping, applying the insulation and vapor seal, and painting the outside surface. All of the work was done with the greatest care in order to make sure that no flaws occurred in the vapor-barrier.

Fig. 7—Chilled water piping in concourse

Results

At the end of the first season's operation no evidence of the penetration of water vapor into the covering has been found. Thus the requirement of effectiveness seemingly has been met. The results of the laboratory tests indicated that permanence might be expected. The record shows that, although the average installed cost per foot for insulating and vapor sealing the 1000 ft of piping was somewhat greater than that of the former practice, it compared favorably with the installed cost of double layer insulation on 10 in. steam piping. Thus, the requirement of moderate cost has been met. The color requirement specified by the architectural designer has been met by the use of cold water paint that was commercially available in the selected color.

Although this investigation of vapor barriers on the insulation on cold water piping resulted in the use of latex, there are probably other materials that might prove equally suitable for such service. It has been demonstrated by the practical application of the new technique described in this article that considerable improvement in accepted insulation practices can probably be effected by investigation of existing problems and development of new materials and methods of application. Publicity on such developments would be greatly beneficial to all engineers interested in thermal insulation construction for heating, piping or air conditioning service.

PRIESTS OF THE SUN GOD

The "thermal engineers" of today are the metaphorical, if not the literal, descendants of the ancient priests of the sun god, declared Dr. Willis H. Carrier before an engineering group last month. It is a noble lineage.

A new classification of refrigerating engineers and heating and power plant engineers under the general heading of thermal engineers was urged by Dr. Carrier. "They should all be classified as thermal engineers, just as radio engineers, electric machinery designers, electric lighting engineers and telephone engineers are all classed as electrical engineers.

"I wish to maintain, contrary to general opinion, that heat engineering is not only the most important but, potentially one of the highest forms of engineering," he continued. "Against the usual idea of heat as a degraded form of energy, I wish to set forth a conception of it as not only the original source of all other energy but as one of the most highly organized forms of energy."

Greater scientific advancement will be shown in the field of thermal engineering than in any other, Dr. Carrier predicted.

DAILY Degree Day Check Saves Heating Steam

R. E. Hieronymus, General Superintendent, Aldis & Co., Explains How Check Is Made, What Results Have Been

SUMMARY—A study of 29 office buildings made early this year showed that buildings which were checking their heating steam consumption daily on the degree day basis used 22 per cent less steam than buildings which were making no degree day check at all, and 17.5 per cent less steam than buildings making a degree day check on a monthly basis only. The importance of making such checks on a daily basis is therefore indicated by this study. . . . Mr. Hieronymus, general superintendent of a real estate and management company with many large buildings under its direction, describes a method of making a daily check which is in wide use in Chicago. He gives results achieved in an actual case—a building which is called here the "Sample Building." This month, he tells of the situation before the heating economy program was initiated. In a second article, he will describe how the steam consumption was reduced 43 per cent. . . . Operating and management engineers not now making some sort of daily check will do well to heed the important message which Mr. Hieronymus presents here

IN a study of 29 leading Chicago office buildings made early in 1940 by the heating and ventilating committee of the Chicago Association of Building Owners and Managers, it was found that the buildings which were checking their heating performance *daily* on a degree day basis were using approximately 22 per cent less steam than buildings which were making no degree day check at all, and 17.5 per cent less steam than those buildings which were making a degree day check on a monthly basis only. This striking demonstration of the advantage of continual, *daily* use of degree day methods indicates that any building not now using this daily method of analysis would do well to institute it without delay.

There are several methods, some of them in chart form, for making such a daily analysis. The method in popular use among Chicago buildings was devised a few years ago and is known locally as the Erlenborne chart.

Assume a building in which little or no attention has heretofore been paid to the subject of efficient heating. The first step in the direction of heating economy is to prepare the chart with the basic information consisting mainly of the daily steam allowance set up on the blank chart, and then to fill in the graphic record of the daily steam consumption. To illustrate the procedure, actual charts from a Chicago building, here referred to as the "Sample Building," are used. By using the method, steam consumption has been reduced 43 per cent. We shall describe the situation before this saving was made this month; a second article will cover the results.

In the first two columns the turning-on and turning-off times for the building are filled in, using the current time schedule. In the third column, "Steam or Fuel Allowance," the steam allowances for the various temperatures are filled in. For a building where the establishment of the base allowance is not an obvious matter the following suggestions are offered.

Establishing Initial Allowance

The amount of steam required for heating varies through quite a wide range with different buildings, being dependent upon type and shape of building, size of building (to some extent), and hours of occupancy. Where office buildings are concerned, it should be satisfactory to start with an allowance of 0.6 lb of steam per degree day per 1000 cu ft of building; or, if the basis be coal instead of steam, 0.1 lb of coal.

Another method of establishing the initial allowance is to take the steam or fuel consumed for the previous season and compute therefrom the average use of steam or fuel per degree day per 1000 cu ft of volume, and to base the chart allowance on this figure. This procedure automatically will insure a condition where approximately one-half the days are above the amount allowed, and approximately one-half the days will be below the allowance.

It may be desirable occasionally to change the amount of allowance and set it up on a new chart. Above all, it is considered necessary to use an allowance such that the engineer may occasionally be under the allowance, and in spite of his best efforts will sometimes go above it. This condition avoids the self-complacency which would result from a chart always "in the blue" and the undesirable discouragement which would attend the operation if the engineer in spite of his best efforts were always "in the red."

Use of the Chart

Using the daily steam consumption figures of some recent month in the building, and obtaining the average daily temperatures from weather bureau records, the performance of the building may now be set out in the chart. In the illustrations this is the month of November, 1936. It is found that the mean temperature on November 1 was 59 F. In the first column of the chart proper draw a small circle around the horizontal line at 59.

It is found that on that day the engineer reported 42,000 lb of steam. Draw a small line through the same vertical column opposite this value in the steam allowance column. It is found by using the factor of 0.6 lb steam mentioned

STEAM OR FUEL CONSUMPTION CHART

For normal conditions turn heat on and off at:

BUILDING SAMPLE MONTH OF Nov 1936.

Contents of Building 4,303,000 Cu.Ft. Degree-Days this month 814.

On:	Off:	Steam or Fuel Allowance *	Mean Temp. °F
		183251	-6
		180670	-5
		178089	-4
		175508	-3
		172927	-2
		170346	-1
		167765	0
		165184	1
		162603	2
		160022	3
		157441	4
		154860	5
		152279	6
		149698	7
		147117	8
		144536	9
		141955	10
		139374	11
		136793	12
		134212	13
		131631	14
		129050	15
		126469	16
		123888	17
		121307	18
		118726	19
		116145	20
		113564	21
		110983	22
		108402	23
		105821	24
		103240	25
		100659	26
		98078	27
		95497	28
		92916	29
		90335	30
		87754	31
		85173	32
		82592	33
		80011	34
		77430	35
		74849	36
		72268	37
		69687	38
		67106	39
		64525	40
		61944	41
		59363	42
		56782	43
		54201	44
		51620	45
		49039	46
		46458	47
		43877	48
		41296	49
		38715	50
		36134	51
		33553	52
		30972	53
		28391	54
		25810	55
		23229	56
		20648	57
		18067	58
		15486	59
		12905	60
		10324	61
		7743	62
		5162	63
		2581	64
		0	65

No Regular Schedule in Use

Note: After Sundays and Holidays turn steam on X Hr. earlier than above.	Day of Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	Day of Week	S							S														S				T			S		
	Steam turned on at	7:30	7:30	6:00	5:30	6:00	6:00	6:00	8:30	6:00	6:00	6:00	6:00	6:00	6:00	8:00	6:00	7:00	6:00	5:30	7:00		8:30	5:30	6:00	6:00	8:00	5:00	6:00	8:30	5:15	
	Steam turned off at	10:A	10:A	6:00	6:00	6:00	6:00	6:00	3:00	6:00	6:00	4:30	5:00	5:30	5:00	2:00	5:00	4:30	6:00	6:00	6:00	5:30	1:30	6:00	6:30	6:30	2:30	6:30	6:00	4:00	6:30	

Note: This chart based on .6 lb. steam * or ____ ____ fuel } per degree-day per 1000 cu. ft. of building volume.

STEAM RECORD:

Total pounds of heating steam consumed 3,134,000

Pounds of steam per degree-day 3850

Pounds of steam per degree-day per 1000 cu. ft. of building volume .894

FUEL RECORD:*

Total _____ of fuel consumed _____

_____ of fuel per degree-day _____

_____ of fuel per degree-day per 1000 cu. ft. of building volume _____

* (Insert unit which corresponds to fuel used, i. e. pounds, gallons, therms, or cubic feet.)

Below normal (blue)

Above normal (red)

{ A.M. in Red
{ P.M. in Black

above that on such a day the engineer should have used 15,486 lb. Therefore, he went in the red on that day to the amount of 26,514 lb and the space between the two marks is therefore filled in with red crayon. (As a matter of fact, this day being a Sunday, in this particular building no steam need have been used.)

The mean temperature on November 2 was 64 F and the theoretical allowance was 2581 lb. The engineer having used 32,000 lb, he was again in the red by an inordinately large amount. (The weakness of the chart system at temperatures approaching 65 F is admitted, for in this zone the whole system hangs on theory which often is awry, though this fact does not constitute a serious weakness.)

OPPOSITE

Steam consumption chart showing typical month before economy was sought. The heating steam exceeded a reasonable allowance on all but three days of the month, no formal turning-on schedule was followed, and the irregularities and excess of heating are apparent from the general appearance of the chart. Steam consumption was 0.894 lb per 1000 cu ft of building volume and per degree day

The mean temperature on November 3 was 46 F, indicated by the small circle so placed, and the steam consumption of 95,500 lb was excessive by the amount of 46,461 lb, or nearly 100 per cent. It will be obvious that though the temperature was 46 F on this day, the steam consumption was approximately sufficient to heat the building on a day of a temperature of 28 F.

This same process is repeated for each day's performance. It will be noted that on Sunday, November 8, with a temperature of 35 F, the steam consumption was 63,000 lb, or less than the customary allowance for that temperature, which is 77,430 lb. Being less than the allowance the space between the temperature and steam marks is filled in with blue. Proceeding on through the chart, it is found that on most of the days the engineer exceeded his average allowance, showing a saving below the allowance only on two additional days, one of them being Sunday the 22nd and the other Thanksgiving Day, the 26th.

Viewing the completed chart for November, 1936, we find an astonishing preponderance of red and the performance obviously is far below the desirable and feasible standard. The next step in order is to bring about the conditions which will substantially change the "complexion" of the monthly chart.

Was Building Too Warm?

To learn the standard of heating which has been produced by this consumption, average temperatures have been taken during the month through the use of a portable recording thermometer from which hourly information has subsequently been taken, averaged, and plotted on coördinate paper. The average temperature condition found to prevail during this sample month is shown in the graph, and the following comments are pertinent:

1) The whole placement of the curve seems to be too high during the hours of occupancy.

2) Likewise, it appears that the building is warmer than need be during the night hours.

3) It is evident that if the building is comfortable during the morning hours, it is overheated during the afternoon hours.

4) It is quite obvious that the tenants on arriving in their offices around 8:30 a.m. find them too hot and they open the windows (and perhaps turn the radiators off) to cool them off.

5) Again when they leave the offices between 5:00 and 5:30 p. m. they close the windows and, heat being supplied in excessive quantities at that time, the temperatures swing up thereafter.

Several inferences as to the possibilities of better economy in heating this building are thus apparent:

a) The afternoon temperature can be limited at least to the temperature prevailing during the morning.

b) It seems probable that even the morning temperature can be reduced.

c) The two "bumps" on the line in the morning and late afternoon can certainly be eliminated.

d) The steam may be turned off earlier at the end of the day, giving lower night temperatures and therefore less heat loss from the building.

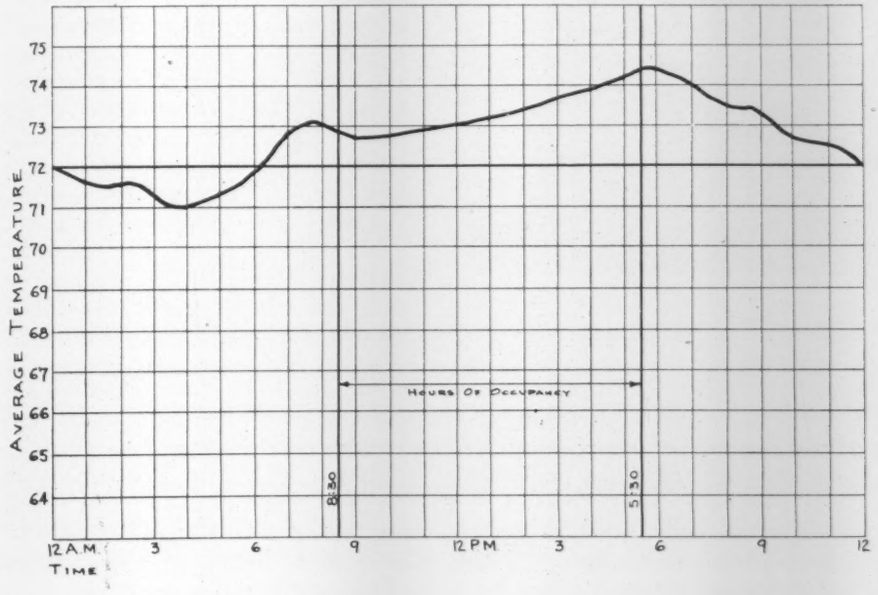
e) The steam can be turned on later in the morning, avoiding the excessive pre-opening temperature.

The obvious wastefulness of the heating process being established and the certainty of a saving being apparent, steps are now taken by various means to reduce the quantity of steam sent upstairs for heating. It is somewhat beyond the scope of this article to go into great detail in this direction, but among the factors indicated are: revision of turning-on and turning-off schedule; reduction of pressure in heating distribution system; turning the steam off for periods on mild days; and perhaps other factors which will be discovered in the process of correction.

In the "Sample Building" all of these processes were followed.

[Mr. Hieronymus' next article will tell how the 43 per cent saving was made.]

The average space temperatures prevailing in the building under the heating practices before heating economy was sought. Implications of curve explained in the text



"OPEN FOR DISCUSSION"

Communications to the Editor

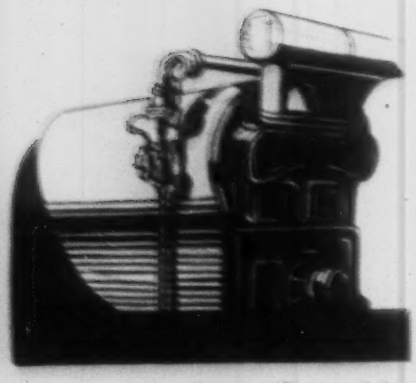
Boiler Ratings

THE EDITOR—

We have read with considerable interest the article entitled How Big is a Boiler?, by Kalman Steiner and Fred Ravnsbeck, in the October HEATING, PIPING AND AIR CONDITIONING. The authors are to be complimented on their very clear exposition of this controversial subject; they have started something which if cleared up could only result in gain, not only to boiler manufacturers but particularly to the consumer.

As manufacturers of steel water tube boilers we are particularly interested in the authors' remarks regarding the diversity of opinion between the SHBI and the ASME as to how boiler heating surface should be measured. We are members of the SHBI but will never concede that the outer, or water surface of fire tubes should be used in measuring heating surface.

The ASME code has always been the authority in such matters and it defines heating surface of boiler tubes as the fire side. We can see



no reason for this conflict and believe that the SHBI rules for tube heating surface measurement favor limiting features of design in a fire tube boiler. The result is that the ultimate consumer does not get the same heating surface as under the ASME code.

A concrete example of the results of measuring heating surface by the two different methods shows how different the SHBI method can be: A fire tube boiler listing 1000 sq ft of tube heating surface when measured by the SHBI method would have actually 900 sq ft of tube heating surface when measured by the ASME method.

We believe it to be self-evident that a water tube boiler whose heating surface is measured in accordance with the ASME requirements is giving the consumer more heating surface than a fire tube boiler whose heating surface is measured by the SHBI recommendation. Yet according to present practice both boilers will be listed on their respective data sheets as having exactly the same heating surface.

As manufacturers of water tube boilers we naturally measure the heating surface of all tubes in accordance with the ASME standard and when meeting a specification based on SHBI rating and heating surface we are giving approximately 30 per cent more tube heating surface than the fire tube boiler manufacturers.

You will see that the technical question raised by the authors is thus reduced to a commercial and competitive one, and unfortunately it is at this point that engineers withdraw from the discussion regardless of what their technical convictions on the subject may be.

If the ASME code is correct in its definition of heating surface, and we believe it is, it would be reasonable to decide this question in favor of this authority.

We are also very much interested in the authors' statement that "the basis of rating water tube boilers is essentially different" and are hoping that they will write a future article on this subject.—J. B. KINGSLEY, Sales Manager, International Boiler Works Co.

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We wish to thank Mr. Kingsley for the good opinion he has expressed of our article on boiler ratings.

We heartily agree that the subject of boiler ratings ceases to be one of academic interest only when one approaches commercial or competitive practice. Then claims of manufacturers of various boiler types are at divergence, and no doubt the ultimate consumer, unable to resolve the sales talk into tangible performance guarantees, is the ultimate loser.

Our company is of course interested in the subject, primarily, only from the aspect of providing the combustion equipment that will enable a boiler to perform in the manner expected of it by its maker and its purchaser. But often we are at a loss to comprehend what that expected performance is to be.

Some of the confusion might be dispelled by abandoning obsolete terms such as boiler horsepower and even boiler heating surface. Certainly that old chestnut, sq ft EDR, is ripe for retirement. Positive values, such as gross Btu output, or lb per hr of steam, might help a good deal.

As to water tube boiler ratings, frankly we had avoided discussing such ratings because we felt that there, at least in the larger units, manufacturers were tending toward expressing boiler performance in terms of evaporation. Certainly few such manufacturers care to commit themselves as to how many square feet of surface constitute a boiler hp of capacity.—KALMAN STEINER, Ace Engineering Co.

Readers of HEATING, PIPING AND AIR CONDITIONING are invited to contribute their views to these "Open for Discussion" pages, which will appear from time to time. Comments on articles we have published, expressions of timely interest on developments in design, installation, operation or maintenance of heating, piping or air conditioning systems, other remarks of value to HPAC's readers—all will be welcomed by THE EDITOR.

HORSEPOWER REQUIREMENTS of Refrigerating Compressors

William Goodman* Presents a Simple Method of Computing Total and Maximum Horsepower

SUMMARY

Computing the horsepower of compressors from tables of "horsepower per cubic foot" of refrigerant vapor circulated is much simpler than computing the horsepower from tables of "horsepower per ton" such as have been widely used heretofore. The use of tables of "horsepower per cubic foot" such as are presented in this article entirely divorces the power requirements of the compressor from its refrigerating capacity. The power required by a compressor depends only upon the compressor itself, whereas its refrigerating capacity depends on other factors external to the compressor. . . . . Furthermore, this article clearly brings out the little-recognized fact that the horsepower of a compressor does not continue to increase steadily with an increase in suction temperature as many believe. There is one suction temperature at which the horsepower is a maximum. Above and below this one suction temperature the horsepower will be lower than the maximum. Formulas—and tables to simplify their use—are presented for computing the suction temperature at which the horsepower is a maximum and for computing the value of the maximum horsepower itself. . . . . Altogether, this article presents a novel approach to the subject of computing the theoretical horsepower of compressors. This approach simplifies basic concepts and should prove useful and illuminating to engineers and others

IN ORDER to compute the theoretical horsepower required for refrigerating compressors, tables of the horsepower per *ton* for various evaporator and condenser pressures have been widely used. However, tables which list instead the horsepower per *cubic foot* of gas compressed have a number of advantages over those which list the horsepower per ton.

One of the principal advantages of the hp per cu ft tables is the fact that the total horsepower required for a compressor can be computed directly from its piston displacement without the necessity of first computing its refrigerating capacity. As is shown later, this provides a direct and arithmetically simple method of computing the total horsepower required.

Secondly, such tables show clearly the little recognized fact that the horsepower of any compressor reaches some maximum value; the horsepower required for a compressor does *not* continue to increase steadily with increasing suction temperature as many believe. Fig. 1 shows the brake horsepower required according to one manufacturer's catalog data for three commercial compressors using "Freon-12," carbon dioxide (CO_2) and ammonia (NH_3). This figure is not intended to show the comparative horsepowers required for the three different refrigerants inasmuch as the data apply to compressors of three different sizes and speeds. The significance of this illustration lies in the fact that it clearly shows that the brake horsepower for each of the three refrigerants has a maximum value at a definite suction temperature. Raising the suction temperature beyond this point decreases the brake horsepower required. Later, a method is given for computing the value of the maximum horsepower and the suction temperature at which this maximum value will occur.

Finally, the values in the tables of hp per cu ft are independent both of the subcooling of the liquid refrigerant ahead of the expansion valve and of the superheat of the refrigerant vapor entering the suction port of the compressor. The *total* horsepower required by a compressor remains the same regardless of the subcooling of the liquid or the superheating of the vapor. However, the *horsepower per ton* will not be the same: it will vary with both the subcooling of the liquid refrigerant and with the superheating of the vapor.

Basing the computation of the energy required on the volume of gas circulated entirely divorces the power requirements of the compressor from its refrigerating capacity. This is desirable because the power required by a compressor for a given suction and head pressure depends only upon the compressor itself, whereas the refrigerating capacity depends upon other factors external to the compressor.

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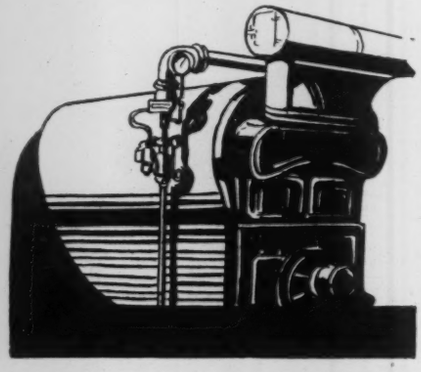

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"Freon-12"—Horsepower per cu ft of Vapor Compressed per Minute

Suction Temperature, F	Suction Pressure		Head Pressure, lb per sq in. Absolute											
			70	80	90	100	110	120	130	140	160	180	200	220
			Head Pressure, lb per sq in. ga											
	Lb Absolute	Lb Ga	55.3	65.3	75.3	85.3	95.3	105.3	115.3	125.3	145.3	165.3	185.3	205.3
			Saturation Temperature, F											
			57.9	66.3	73.9	80.9	87.3	93.4	99.1	104.5	114.5	123.7	132.1	139.9
-20	15.28	0.58	0.1099	0.1201	0.1294	0.1376	0.1447	0.1520	0.1582	0.1643	0.1744	0.1835	0.1918	0.2005
-18	16.01	1.31	.1111	.1218	.1314	.1400	.1475	.1551	.1614	.1678	.1784	.1878	.1965	.2055
-16	16.77	2.07	.1124	.1236	.1336	.1425	.1503	.1582	.1649	.1714	.1824	.1924	.2013	.2106
-14	17.55	2.85	.1136	.1253	.1356	.1449	.1531	.1612	.1682	.1751	.1865	.1968	.2062	.2161
-12	18.37	3.67	.1147	.1268	.1376	.1472	.1558	.1643	.1715	.1786	.1906	.2013	.2111	.2213
-10	19.20	4.50	0.1155	0.1282	0.1393	0.1493	0.1583	0.1671	0.1746	0.1821	0.1946	0.2056	0.2158	0.2266
-8	20.08	5.38	.1163	.1293	.1412	.1516	.1608	.1700	.1778	.1856	.1986	.2101	.2207	.2318
-6	20.98	6.28	.1170	.1306	.1428	.1536	.1633	.1728	.1810	.1890	.2025	.2145	.2255	.2372
-4	21.91	7.21	.1175	.1317	.1445	.1556	.1657	.1756	.1841	.1924	.2064	.2188	.2303	.2425
-2	22.87	8.17	.1179	.1327	.1459	.1575	.1680	.1783	.1871	.1957	.2104	.2233	.2352	.2478
0	23.87	9.17	0.1181	0.1334	0.1472	0.1593	0.1702	0.1809	0.1901	0.1988	0.2141	0.2275	0.2399	0.2530
2	24.89	10.19	.1181	.1340	.1483	.1608	.1722	.1833	.1929	.2020	.2179	.2317	.2446	.2583
4	25.96	11.26	.1181	.1345	.1493	.1622	.1740	.1856	.1956	.2050	.2215	.2359	.2493	.2635
6	27.05	12.35	.1177	.1347	.1502	.1633	.1758	.1878	.1980	.2079	.2251	.2399	.2539	.2686
8	28.18	13.48	.1170	.1347	.1507	.1644	.1772	.1897	.2004	.2105	.2284	.2438	.2582	.2736
10	29.35	14.65	0.1161	0.1344	0.1511	0.1652	0.1786	0.1916	0.2025	0.2132	0.2315	0.2476	0.2626	0.2785
12	30.56	15.86	.1151	.1342	.1514	.1661	.1799	.1933	.2047	.2158	.2348	.2515	.2669	.2834
14	31.80	17.10	.1139	.1335	.1514	.1666	.1809	.1949	.2067	.2182	.2380	.2551	.2713	.2884
16	33.08	18.38	.1123	.1327	.1513	.1669	.1819	.1964	.2087	.2205	.2410	.2587	.2756	.2934
18	34.40	19.70	.1107	.1318	.1511	.1673	.1830	.1978	.2106	.2230	.2442	.2625	.2799	.2984
20	35.75	21.05	0.1090	0.1309	0.1507	0.1675	0.1837	0.1991	0.2123	0.2252	0.2473	0.2662	0.2843	0.3035
22	37.15	22.45	.1068	.1294	.1500	.1673	.1842	.2001	.2139	.2272	.2499	.2698	.2882	.3081
24	38.58	23.88	.1040	.1273	.1488	.1667	.1844	.2006	.2149	.2285	.2522	.2728	.2919	.3126
26	40.07	25.37	.1010	.1251	.1474	.1658	.1841	.2010	.2158	.2301	.2544	.2755	.2956	.3167
28	41.59	26.89	.0975	.1224	.1454	.1646	.1832	.2010	.2160	.2308	.2560	.2783	.2986	.3205
30	43.16	28.46	0.0937	0.1196	0.1435	0.1633	0.1826	0.2010	0.2165	0.2319	0.2580	0.2806	0.3020	0.3246
32	44.77	30.07	.0899	.1166	.1411	.1616	.1816	.2003	.2166	.2325	.2592	.2827	.3049	.3284
34	46.42	31.72	.0856	.1132	.1385	.1598	.1805	.1999	.2165	.2332	.2609	.2852	.3080	.3322
36	48.13	33.43	.0807	.1093	.1355	.1574	.1789	.1989	.2161	.2332	.2618	.2868	.3107	.3357
38	49.88	35.18	.0755	.1051	.1322	.1553	.1772	.1979	.2158	.2333	.2630	.2889	.3134	.3393
40	51.68	36.98	0.0700	0.1004	0.1284	0.1521	0.1749	0.1963	0.2148	0.2329	0.2636	0.2904	0.3160	0.3425
42	53.51	38.81	.0640	.0954	.1243	.1489	.1722	.1941	.2134	.2322	.2636	.2913	.3177	.3451
44	55.40	40.70	.0576	.0900	.1195	.1453	.1691	.1920	.2117	.2311	.2636	.2922	.3194	.3478
46	57.35	42.65	.0506	.0841	.1150	.1412	.1663	.1896	.2099	.2300	.2638	.2930	.3213	.3506
48	59.35	44.65	.0435	.0781	.1100	.1371	.1629	.1870	.2081	.2288	.2634	.2939	.3227	.3534
50	61.39	46.69	0.0358	0.0719	0.1045	0.1325	0.1591	0.1840	0.2058	0.2272	0.2629	0.2945	0.3242	0.3554
52	63.49	48.79	.0279	.0648	.0984	.1277	.1549	.1805	.2029	.2250	.2620	.2942	.3253	.3575
54	65.63	50.93	.0190	.0571	.0918	.1221	.1500	.1766	.1997	.2225	.2606	.2938	.3258	.3587
56	67.84	53.14	.0096	.0490	.0848	.1160	.1449	.1722	.1962	.2198	.2587	.2933	.3261	.3605
58	70.10	55.40	------	.0402	.0772	.1094	.1392	.1675	.1921	.2164	.2567	.2924	.3261	.3615

that these values of tonnage capacity may be incorrect because of the existence of subcooled liquid and superheated vapor. Because of this, computations for the total horsepower frequently prove confusing, especially to those who have occasion to make such computations only occasionally.

The method of figuring the horsepower of compressors by means of the hp per cu ft tables entirely avoids the necessity of considering either the subcooling of the liquid refrigerant or the superheating of the vapor. As a result, these computations are not only simple, but they also eliminate the possibility of making an error when subcooling of the liquid or superheating of the vapor occurs. The results obtained by means of these tables are always theoretically correct regardless of either the state of the liquid entering the expansion valve or of the vapor entering the suction port of the compressor.

Computation of Theoretical Horsepower

In order to compute the theoretical horsepower required, the volume of vapor—at the suction pressure—circulated by the compressor is multiplied by the value of the theoretical horsepower per cubic foot as obtained from the table, or

$$Thp = hp\ Q \quad \ldots\ldots [1]$$

If the volumetric efficiency[1] of compressors were 100 per cent, the volume of vapor that could be circulated would exactly equal the piston displacement—that is, the volume swept by the piston per minute. Of course, the volumetric efficiency of all actual compressors is less than 100 per cent, and consequently the volume of vapor circulated is less than the piston displacement of the compressor. The actual volume of vapor circulated is found by multiplying the piston displacement by the volumetric efficiency, or

$$Q = V\ E_v \quad \ldots\ldots [2]$$

The theoretical horsepower required can be computed from the piston displacement by means of the following formula, which is obtained by substituting [2] into [1]:

$$Thp = hp\ V\ E_v \quad \ldots\ldots [3]$$

The theoretical horsepower computed by means of equation 3 can be used to find the brake horsepower actually required to drive the compressor if the over-all power efficiency of the compressor is known. The over-all power efficiency may be defined as the ratio of the theoretical horsepower for isentropic compression to the brake horsepower actually required. Like volumetric efficiency it can be determined only by experiment. The brake horsepower is found by dividing the theoretical horsepower by the over-all efficiency.

Hence,

$$Bhp = \frac{Thp}{E_p} \quad \ldots\ldots [4]$$

or from equation 3,

$$Bhp = hp\ V\ \frac{E_v}{E_p} \quad \ldots\ldots [5]$$

The following example illustrates the method of using equation 5 in conjunction with the tables.

Example: A three cylinder "Freon-12" compressor has a bore of 3½ in., a stroke of 4 in., and a speed of 350 rpm. The condenser pressure is 115.3 lb ga and the evaporator temperature is 34 F. The volumetric efficiency of the compressor is 82 per cent and the over-all power efficiency is 75 per cent. Find the brake horsepower required for the compressor.

Solution:

$$V = 3 \times \frac{3.142}{4} \times (3.5)^2 \times 4 \times \frac{350}{1728} = 23.4 \text{ cfm}$$

From the table hp = 0.2165 hp per cu ft of vapor compressed per min.

Using Equation 5,

$$Bhp = 0.2165 \times 23.4 \times \frac{82}{75} = 5.5.$$

[*Following sections of this discussion will cover superheated suction vapor, critical compression ratio, maximum theoretical horsepower, maximum brake horsepower, and will include an ammonia table and other associated data.*]

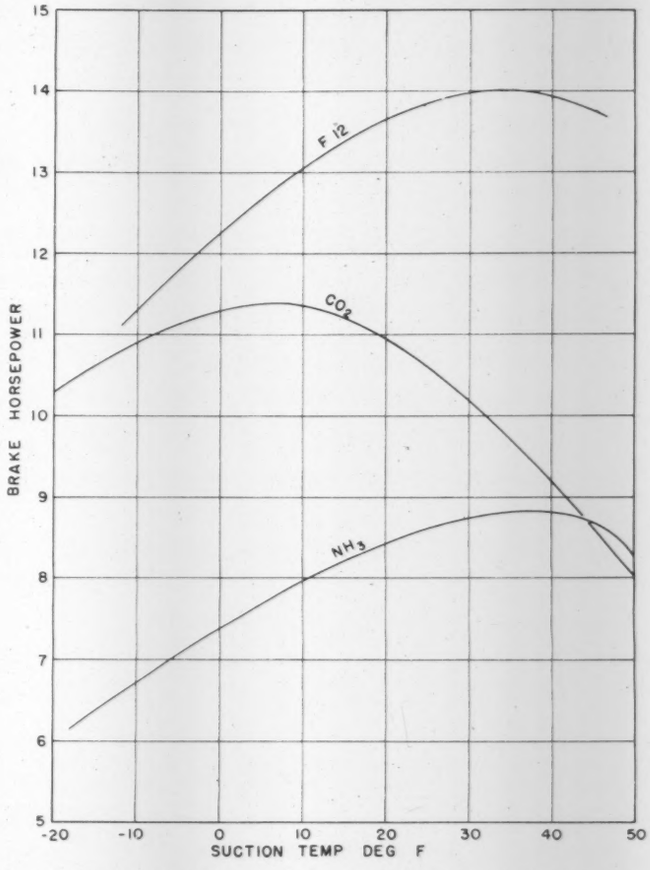


Fig. 1—Brake horsepower for commercial compressors for three different refrigerants. Note that for each refrigerant the brake horsepower passes through a maximum point. This figure is *not* intended to show comparative horsepowers for the refrigerants as it applies to compressors of different sizes and speeds

[1]Volumetric efficiency is the ratio of the volume or weight of gas actually circulated by the compressor to the volume or weight that it could theoretically circulate. The theoretical weight is computed from the piston displacement and the density of the suction vapor. Volumetric efficiency must be determined experimentally.

Symbols

Bhp = brake horsepower required.

E_p = over-all power efficiency, per cent, $= \frac{Thp}{Bhp}$.

E_v = volumetric efficiency of compressor, per cent.

hp = theoretical hp per cu ft of vapor compressed as obtained from the table.

Q = volume of vapor (at the suction pressure) circulated by the compressor, cfm.

Thp = theoretical horsepower required for isentropic compression.

V = piston displacement of compressor, cfm.

Panel Heating— with WARM Well Water

KLAMATH FALLS is situated in southwestern Oregon near the California border, and lies in that portion of the Cascade mountain range extending between Crater Lake—a beautiful lake in the crater of an extinct volcano—and Mount Lassen, the only active volcano in the United States. This entire strip of mountains is of volcanic origin. Underground lakes of hot water are frequently found here and supply many hot springs, or they may be tapped by drilling a well. Such a lake exists under the City of Klamath Falls, where many hot water wells have been drilled and the water used for heating purposes by employing low temperature radiators and convectors, or blast heaters with fans.

Engineering may be defined as utilizing natural resources to the best advantage; the service and repair garage at Klamath Falls, Ore., which is described here is a pertinent example. Underground lakes of hot water in this volcanic region may be tapped by wells and the water used for heating. The well serving this garage is 490 ft deep and at the 475 ft level the water temperature is 145 F. . . . This water is used in a panel heating system. In the garage area, floor coils are used in order to warm the floor and create comfortable and efficient conditions for the men working under snow covered and ice caked cars. In the office portion, the pipe coils were placed in the suspended plaster ceiling. . . . The well has a 3 in. pipe extending down into it, and a 2 in. return riser enclosed in a 4 in. pipe with insulation between the 2 in. and 4 in. pipes. The water is warmed as it descends in the 3 in. pipe and is prevented from recooling as it rises in the insulated 2 in. pipe. . . . The method of heating the water is therefore unique and couldn't be applied in very many cases. However, the panel heating system could be utilized with water from any source

Last year the Specialized Service Co. built a service and repair garage. The building is 50 ft wide by 150 ft long and has a concrete floor pitching toward the rear of the building. The walls are 8 in. tile and the roof is of the open truss type with only sheathing and roofing material on top. In the left front are offices with a suspended ceiling having several skylights, and a storage basement is built under the offices.

On the site was a 10 in., 490 ft well with casing extending down 125 ft. The upper water level is about 30 ft below ground level and the water has a temperature of 60 F. A pumpage of 25 gpm for 72 hr showed a drop in water level of only 27 ft with a slight increase in water temperature. At a depth of 150 ft the water has a temperature of 104 F and this temperature gradually increases to 145 F at a depth of 475 ft. Calculations showed that it would be possible to get a water temperature in the heating system of nearly 120 F and that it would be feasible to use this well and secure very comfortable conditions in the garage at a very low cost and without the use of further insulation in the walls and roof by the use of panel heating.

Water Heated in Well

The "heating plant" consists of a 3 in. pipe extending down in the well to a depth of 450 ft and a 2 in. return riser enclosed in a 4 in. pipe with insulation between the 2 in. and the 4 in. pipes. The panel heating water is warmed as it descends in the 3 in. pipe and is prevented from recooling as it rises by the insulation over the 2 in. pipe. It is circulated by a 1½ in. centrifugal pump with a capacity of 40 gpm at 50 ft head, driven by a 2 hp motor.

During the winter cars entering the garage are usually caked with ice and snow, and men working under them on a cold floor feel very uncomfortable and cannot work efficiently. To counteract these conditions, the panel heating coils were placed in the concrete floor in the garage. In the offices, which have a storage basement under them, the coils were placed in the suspended plaster ceiling.

The Pipe Coils

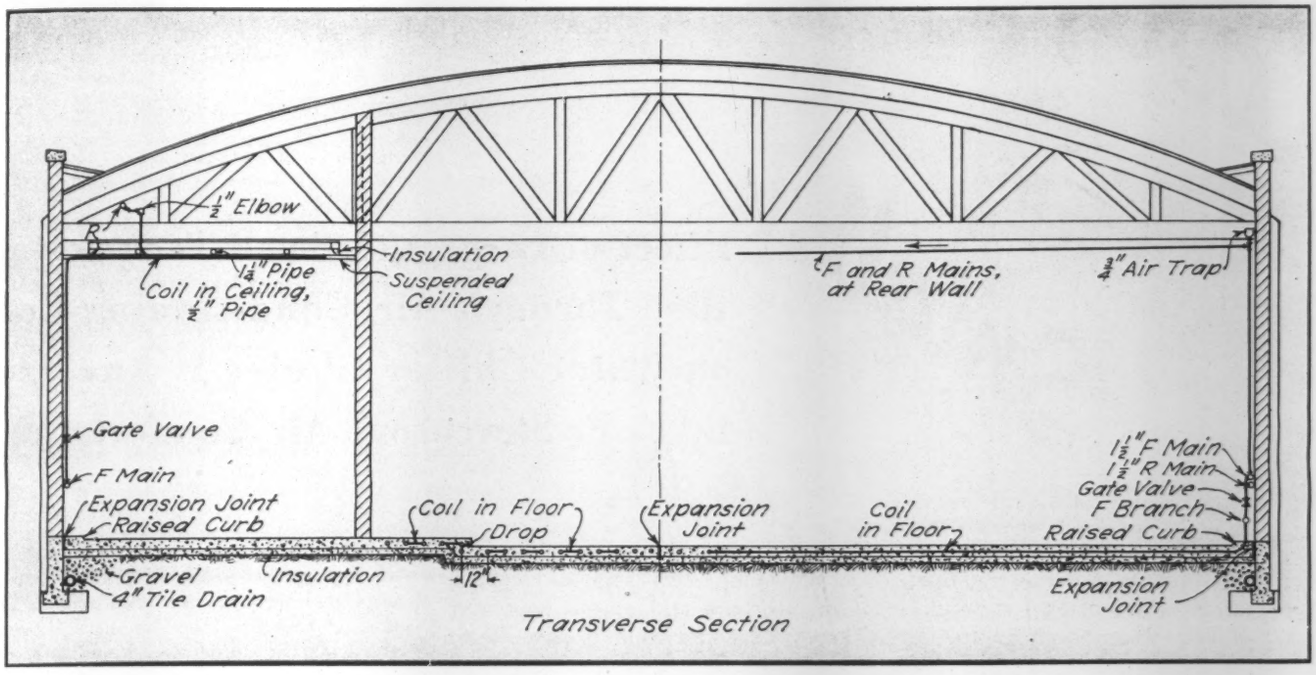
The panel heating system comprises about 9000 lineal feet of pipe coils. Expansion joints divide the floor into bays 25 ft, 0 in. by 18 ft, 9 in. Each bay has an independent group of two or three coils connected in multiple and supplied with a shut-off valve on the flow connection and an equalizing non-reflux elbow on the return end for balancing the system and avoiding a reflux of water in case of damage to any coil. The flow and return mains extend along the side walls, pitch upward and have an air relief valve on the ends. The branches to the coils feed downward from these mains.

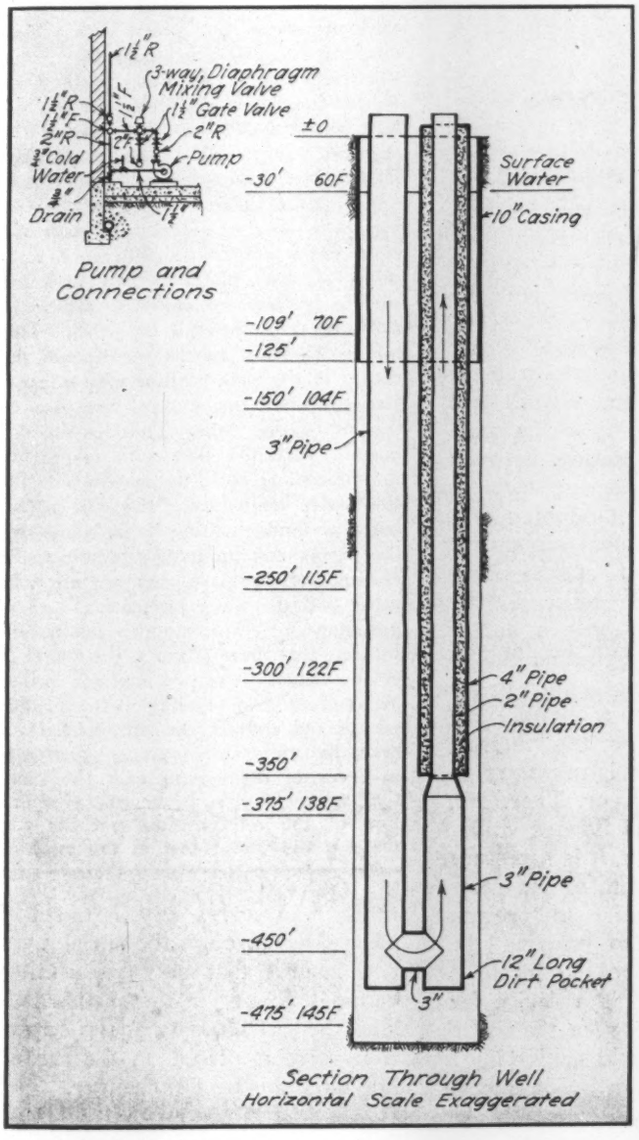
The garage floor is laid on a 3 in. layer of insulation consisting of crushed tufa, which is a native variety of volcanic rock, and is thoroughly under-drained. Neither the walls nor the roof are insulated and the ends of the building have large windows and garage doors.

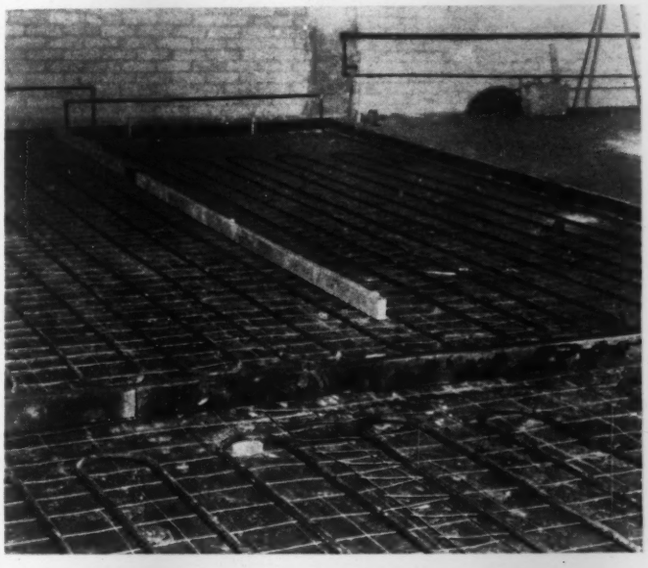
The plant has been in operation since the first of the year and during the coldest weather experienced last winter, plus 15 F, it was found that with only 90 F water the building was warmer than necessary and proved to be very comfortable to the workmen, whose efficiency was not impaired by cold floors.

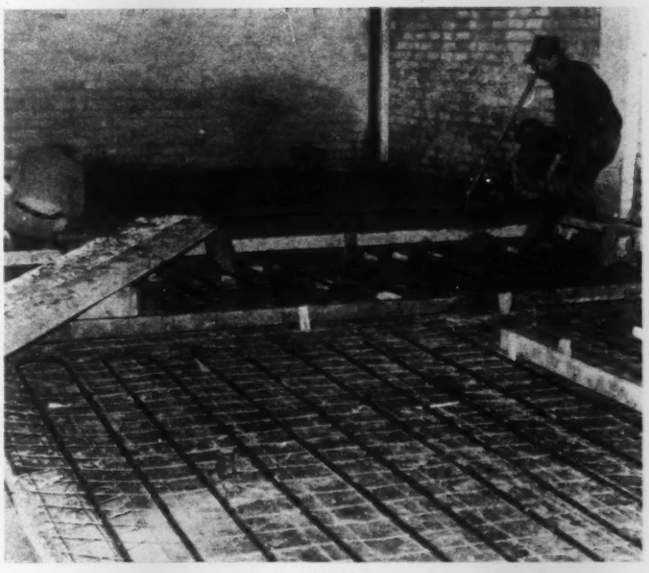
The building was designed by Howard R. Perrin, architect, and the writer designed the heating system, which was installed by Lorenz Co. It was licensed from Richard Crittall Co., Ltd., through Wolff & Munier, Inc.

Erwin L. Weber, Consulting Engineer, Describes Garage System Which Creates Efficient Work Conditions


1/2" Elbow
R
1 1/4" Pipe
Coil in Ceiling, 1/2" Pipe
Insulation
Suspended Ceiling
F and R Mains, at Rear Wall
3/4" Air Trap
Gate Valve
F Main
Expansion Joint
Raised Curb
Coil in Floor
Drop
Expansion Joint
Coil in Floor
1 1/2" F Main
1 1/2" R Main
Gate Valve
F Branch
Raised Curb
Gravel
4" Tile Drain
Insulation
12"
Expansion Joint
Transverse Section


1 1/2" R
3-way, Diaphragm Mixing Valve
1 1/2" F
1 1/2" R
1 1/2" Gate Valve
2" R
2" R
Pump
3/4" Cold Water
3/4" Drain
1 1/2"
Pump and Connections
±0
-30' 60F
Surface Water
10" Casing
-109' 70F
-125'
-150' 104F
3" Pipe
-250' 115F
-300' 122F
4" Pipe
2" Pipe
Insulation
-350'
-375' 138F
3" Pipe
-450'
12" Long Dirt Pocket
3"
-475' 145F
Section Through Well
Horizontal Scale Exaggerated





Large or Small?

Effect of Large and Small Temperature Rise Through Air Conditioning Coils on Water Chiller Choice Is Analyzed

by F. F. Stevenson, Air Comfort Corp.

SUMMARY—In connection with cooling air by means of artificially chilled water circulated through coils, two schools of thought have developed among designers and engineers. One recommends a comparatively small water temperature rise through the air cooling coils, using large quantities of water, and the other advocates the use of less water, with a high temperature rise through the coils. Choosing one or the other method involves important decisions in the design of the system and the cost of the required equipment. . . . In the October HPAC, Mr. Stevenson analyzed the factors involved which concern the air cooling coils — water velocity through the coils, mean temperature difference, ratio of specific heats of the air and the water, surface temperature of coils, and water pressure drop through the coils. This month, he takes up the question of the choice of the water chiller with either a large or small temperature rise through the air cooling coils. The October discussion indicated that with respect to the air cooling coils, the system with the low water temperature rise was apparently preferable, although in comparing the piping and pumping equipment, the system with the large temperature rise, using half the water circulation, had an advantage. . . . This month's conclusions indicate that there is not a great deal to choose between the two methods insofar as the costs of cooling coils, piping, pumps and chillers are concerned. However, the refrigerant cost is apparently in favor of the system with the small temperature rise, as is the cost of operation of the refrigeration machine and perhaps the initial cost of the machine

IN THE October HPAC, I endeavored to analyze the operating values of two recirculating chilled water systems for air conditioning, as there are two schools of thought on temperature rise; one recommends a small rise in temperature of water through the coils, and the other advocates less water and a large rise. System No. 1 was assumed to use 3 gpm of water per ton with an 8 F rise through the cooling coils and System No. 2 was assumed to require 1½ gpm per ton with a 16 F rise.

In comparing these two systems, we now come to a most important piece of equipment, the water chiller. There are two principal types of chillers in general use, the flooded type, which circulates the water through tubes and expands the refrigerant in the shell (and has been in use for many years), and the dry expansion chiller, which circulates the refrigerant through the tubes and allows the water to flow in the shell. The dry expansion type is a more recent development.

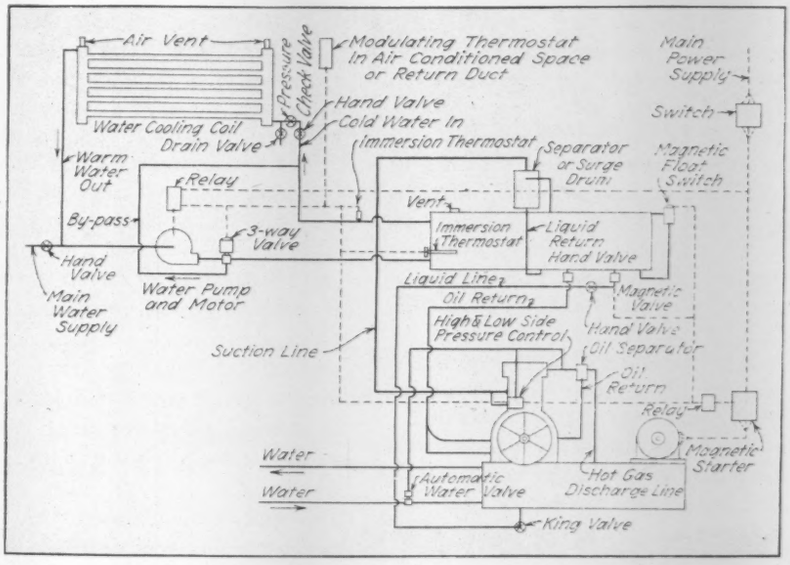
There is also a third type of water chiller, which is a spray chiller, its name being derived from the fact that it sprays the refrigerant over water tubes. It was first developed in Europe and the idea back of it is to get a high rate of heat transfer, with the use of a minimum of refrigerant. The liquid is not "flooded" in the shell, but is collected in a sump in the base of the shell, where it assumes a temperature corresponding to that of the suction pressure and it is then pumped to the top of the shell and sprayed over the tubes. A refrigerant pump, two sets of controls, surge drums and an oil separator are needed for this chiller. It is made only in large sizes.

We shall confine our analysis to the flooded and dry expansion chillers; each has its strong and its weak points.

Full Flooded Chiller

The flooded chiller may be operated full flooded or semi-flooded. By full flooded we mean that the level of liquid refrigerant is at all times close to the top of the shell, up to the limit of safety requirements. This means that little or no superheating of the vapor is done in the shell, enables all of the heat transfer surface to do maximum work and it can operate efficiently with a small difference in temperature between the refrigerant and leaving water.

However, this method of operation requires additional equipment to enable the chiller to operate properly. In using water chillers for air conditioning service with a fluctuating load, many engineers like to control the refrigerant supply to the chiller by means of a thermal expansion valve. For the thermal valve to function, it is necessary to have superheated vapor. Therefore, when we use a full flooded chiller with a thermal valve, it is necessary to place a surge drum or separator at the suction outlet to prevent liquid particles from entering the suction line and then to locate a superheater (which is a device for exchanging heat between the warm liquid line and the cold suction line) after the surge drum. The superheater evaporates any liquid that has passed through the surge drum and insures that only superheated vapor is flowing in the suction line. The thermal element of the expansion valve is placed on the suction line after this heat exchanger.



A typical water cooling system. Compressor is of the conventional reciprocal single acting type, with water cooled condenser, using "Freon." Cooler is the so-called "flooded" type, with water circulating through tubes and refrigerant expanding in the shell. Entire shell is kept filled with liquid, control being had by means of a magnetic liquid line valve, controlled by a float switch. Use of a surge drum prevents liquid particles from being brought into the suction line.

Thermostat in the water supply line can be set at any desired temperature, say 45 F; when the supply water goes above this point, compressor starts. Thermostat in the chiller is set at 35 F to prevent a freeze up. When the water temperature goes below this point, compressor stops. Three way valve in water line is actuated by a modulating thermostat, placed in the air conditioned space or in the return air duct. It proportions the mixture of chilled and bypass water supplied to the coil. Upon a continued demand for cooling, the bypass line is closed off entirely and all chilled water is sent to the coil. Upon a continued demand for heat, all bypass water is sent to the coil and when the supply of chilled water is entirely cut off, a control from the three way valve through a relay to the pump motor stops the pump. Then the thermostat in the chilled water line quickly stops the compressor.

The cooler is operating full flooded, there is little or no superheated gas in the top of the shell and the location of the water inlet and outlet is not critical. However, if the cooler were operating semi-flooded, with superheated gas and a refrigerant temperature differential, then it would be desirable to have the water come in at top and come out at bottom, giving the cooler the advantage of counterflow between water and refrigerant

Thermal valve control is usually confined to the smaller sizes of flooded chillers. The larger sizes—and some of the smaller sizes as well—are frequently controlled by means of a low side float valve. This valve may be of the type that controls the piston of a pressure valve placed in the liquid line or it may close an electrical circuit to energize and open a solenoid valve which is placed in the liquid line. By using the proper valve, a modulating action can be attained which is very desirable in handling fluctuating air conditioning loads. This method of operation eliminates the need of a superheater, but a surge drum is still required.

Semi-Flooded Chiller

The semi-flooded type of chiller does not maintain a liquid level close to the top, but allows a space to exist between the surface of the liquid and the top of the shell in which the vapor can superheat. This eliminates the use of both the surge drum and the superheater, the thermal bulb of the expansion valve being clamped on the suction outlet.

However, the cooling surfaces of the tubes at the top of the shell carry only a sensible heat transfer between the water and vapor, which is so insignificant that it is seldom calculated. Therefore, as this area of tube surface is ineffective, it must be subtracted from the total chiller cooling surface and there will need to be a greater difference between the temperature of the leaving water and the refrigerant. So, with the semi-flooded operation we need a chiller with greater surface. The coefficient of heat transfer in flooded and semi-flooded chillers varies with the water velocity through the tubes; this water velocity should range from 2½ to 4 ft per sec. The number of water passes will naturally vary with the water rise and System No. 2 will have approximately twice the number of passes as No. 1, as well as a much greater water pressure drop.

Flooded chillers also require an oil separator, because a flooded shell is a natural oil trap. Some engineers maintain that with the suction temperatures used in air conditioning work, they can operate a flooded chiller without an oil separator, but this is not recommended by my experience.

A major item with the flooded type chillers is the refrigerant charge. Depending upon the liquid level maintained and the operating mean temperature difference, it requires from 8 to 15 lb of "Freon" per ton of refrigeration to charge them effectively, so it is obvious that for large plants this constitutes an important factor both in the initial and the maintenance cost.

Dry Expansion Chiller

The dry expansion chiller expands the refrigerant in tubes. Vertical baffles of various types are placed inside the shell to increase water velocity and turbulence of flow. The less water used, the smaller the spaces between the baffles. The use of this chiller may do away with many of the accessories which may be necessary with the flooded type. The refrigerant coils may be controlled similarly to air cooling coils, with thermal expansion valves operating on vapor superheat. No surge drums, superheaters or oil separators may be necessary, although in some cases a superheater and an oil separator are used.

However, the coefficient of heat transfer is not as great as in a flooded chiller so more surface will be needed for equal capacity. The coil may be divided into refrigerant circuits, the same as an air cooling coil, or designed as a single circuit. It should be remembered that the over-all rate of heat transfer is much greater from water to refrigerant than it is from air to refrigerant and the load per circuit will be high. Therefore, pressure losses should be carefully checked before selecting the number of circuits.

The problems with these chillers are to maintain a sufficient water velocity through the baffled shell in order to secure a satisfactory heat

transfer rate and to secure a uniform refrigerant feed. It is usually agreed that not less than 3 gpm of water per ton of refrigeration should be used with these chillers, for with less water the velocity and turbulence are low and the rate of heat transfer falls rapidly. So much additional surface is thereby required that the operation is uneconomical from the standpoint of chiller size and cost. The difference between the temperature of the leaving water and the refrigerant is considerably greater than with the flooded chillers.

The important difference between flooded chillers and dry expansion chillers is the amount of refrigerant needed. Dry expansion chillers use only from 1 to 3 lb of "Freon" per ton, which constitutes a large saving over the amount used by flooded chillers if the plant is of large size. This item may well be the determining factor in the design of a chilled water system.

As our System No. 2 uses but 1½ gpm of water per ton, it would be unwise to attempt to operate it with a dry expansion chiller. This constitutes a most serious objection to a system using a small amount of water with a high temperature rise. One way of getting past this objection is to operate the chiller with the proper amount of water (more than would be needed to supply the cooling coil) and to run a bypass line around the chiller. This would circulate the excess water through the chiller and back again and would add very little to the load. However, it would require additional piping, valves, etc.

Mean Temperature Difference

It would be well to get a clear picture of operating mean temperature difference (MTD) before proceeding further. MTD has an all important bearing on the size of the chiller, for it fixes the amount of surface required and also the coefficient of heat transfer. The greater the temperature difference between water and refrigerant, the greater the value of the heat transfer coefficient.

Then why not operate a chiller with the greatest possible MTD, which would effect a saving in chiller size and also in the refrigerant charge?

To attain a high MTD we must operate with a high inlet water temperature, a low leaving water temperature or a combination of both. However, we have definite limits in either direction. If we use a high water temperature leaving the cooling coil, the operation of the coil may not be efficient, as explained in October. If we use a low leaving water temperature out of the cooler, it means that the refrigeration machine must work on a low suction pressure, which may not be desirable. So we see that a high MTD is in many cases not practical. For a high entering water temperature, the flooded type of chiller is probably the best, because of the small difference in temperature between leaving water and refrigerant. This enables it to cool water through a wide range, without requiring too low a suction temperature. By the same token, the dry expansion chiller is not so desirable for wide range work.

Comparison of Chillers

Let us see how the various types of chillers would perform with our Systems No. 1 and No. 2. Consider the flooded type first.

Disregarding water losses or gains in the pipe lines, we found in October that System No. 1 requires a chiller to take water in at 53 F and deliver it at 45 F. For System No. 2 the chiller must receive water at 57 F and deliver it at 41 F for comparable coil performance. Selecting a difference of 6 deg between leaving water and refrigerant temperature for flooded operation, we shall need a refrigerant temperature of 39 F with System No. 1 and 35 F with System No. 2, which forces the refrigeration machine for No. 2 to operate on a suction temperature 4 deg lower than for System No. 1.

With the first chiller, we have a smaller mean temperature difference than with the second. Using a flooded type chiller, this difference in MTD with about equal water velocity through the tubes and approximately twice as many water passes in chiller No. 2 as in No. 1, will enable us to save approximately 15 per cent of heat transfer surface in chiller No. 2. It is a matter of preference whether the full flooded or semi-flooded chiller be used, but it seems to me that for System No. 2 the full flooded type would give better results. To sum up, System No. 2 with the high water rise, will use a smaller flooded chiller than No. 1 and less refrigerant. Notwithstanding this, many operating engineers prefer to use a flooded chiller with a lower MTD and fewer water passes.

Comparing the use of flooded or dry expansion chillers with System No. 1, we find that the flooded chiller has the greater heat transfer coefficient and therefore uses less surface with the same MTD, which may enable the use of a smaller flooded chiller. This saving, however, may be outweighed by the need of surge drums, superheaters, oil separators and a greater refrigerant charge in the flooded type.

In the operation of dry expansion chillers, there will be a temperature drop of about 2 to 3 deg through the coil, caused by refrigerant pressure loss. If the same refrigerant expansion temperature is maintained, this will force the refrigeration machine to operate at a lower suction temperature. With System No. 1, this is a point in favor of the flooded chiller.

Comparing Systems No. 1 and No. 2 with respect to water chillers, we find that System No. 2 will effect a saving in the size of a flooded chiller, but that System No. 1 can use a dry expansion chiller with considerable savings in refrigerant charge and in accessories.

Conclusion

In conclusion, if we operate System No. 2 with a colder entering water than System No. 1, there is not a great deal to choose between the two systems in the costs of cooling coils, piping, pumps and chillers. However, since it is not desirable to use a dry expansion chiller with System No. 2, the cost of the refrigerant will be greatly in favor of System No. 1. Also, due to differences in suction temperatures, the cost of operation of the refrigeration machine—and perhaps the initial cost—will be in favor of System No. 1, regardless of whether a flooded or dry expansion chiller is used.

Supporting Horizontal Tanks

By Max M. Salzman, Structural Engineer

WE ARE seeking a formula for the spacing of concrete saddles supporting horizontal tanks, a subscriber to HPAC—chief draftsman of an industrial firm—writes.

For example, how many supporting saddles would be necessary and on what centers would these supports be placed for a tank made of ⅜ in. steel, welded construction, size 10 ft diameter by 33 ft out to out of standard dished heads? The tank contains liquid with a specific gravity of 1.

In reply to this reader's question, formulas for spacing of concrete saddles supporting horizontal tanks are not available because the mathematical analysis is quite complex.

However, certain information in the form of data compiled from the experience of reputable tank manufacturers is available. The accompanying tables show proper spacing of concrete saddles for various lengths of tanks, 10 ft 6 in. diameter and 11 ft 0 in. diameter, which have been standardized by one tank manufacturer. These tables also show dimensions of supports and proper design of footings for average good soil conditions, such as clay or sand.

As a general rule, tanks of such sizes as shown in these tables, if provided with substantial stiff flat heads, can be simply supported by welding two channel supports to each head (or end) of the tank. These channels act as stiffeners as well as supports and should be of sufficient sectional area to act as columns for the weight of the tank, plus contents. They should be spaced about half the diameter of the tank apart.

Checking the Stresses

To check the more important stresses in such a design, consider a tank of welded construction, 10 ft 0 in. inside diameter, 33 ft 0 in. in length, made of ⅜ in. steel plates. The tank is filled with water.

Following is an investigation of stress due to beam action:

Section modulus S of a hollow circle with axis of moments through its center is:

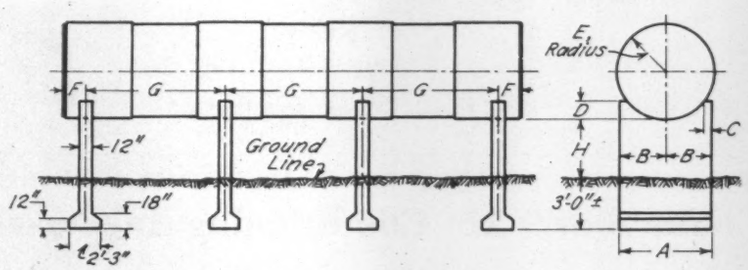
$$S = 0.098175 \frac{(d^4 - d_1^4)}{d}$$

(Multiply above by 1728 if dimensions are in feet).

where d and d_1 are outside and inside diameters, respectively, in inches.

Spacing of concrete saddles for various lengths of tanks

Data by courtesy Graver Tank & Mfg. Co.



Heavy coat of tar to be placed in saddles to prevent rusting.

Bottom of footings must be below frost line.

Maximum bearing pressure on soil—4000 lb per sq ft, based on liquid at 47 lb per cu ft (6.3 lb per gal) Concrete at 150 lb per sq in.

Concrete mixture 1:3:5; 4.5 sacks cement, 0.51 cu yd sand, 0.85 cu yd 1" stone per cu yd of concrete.

10'-6" Diameter Tanks

Length of Tank	Number of Piers	A	B	C	D	E	F	G	H	cu yd Concrete	H	cu yd Concrete
11'-11"	2	9'-0"	4'-6"	1'-5"	1'-0"	5'-3"	7"	10'-9"	7'-0"	7.8	1'-0"	3.8
15'-7"	2	9'-0"	4'-6"	1'-5"	1'-0"	5'-3"	1'-7½"	12'-4"	7'-0"	7.8	1'-0"	3.8
17'-9"	2	9'-0"	4'-6"	1'-5"	1'-0"	5'-3"	1'-10½"	14'-0"	7'-0"	7.8	1'-0"	3.8
18'-5"	2	9'-0"	4'-6"	1'-5"	1'-0"	5'-3"	2'-2½"	14'-0"	7'-0"	7.8	1'-0"	3.8
20'-7"	2	9'-0"	4'-6"	1'-5"	1'-0"	5'-3"	3'-3½"	14'-0"	7'-0"	7.8	1'-0"	3.8
23'-7"	3	9'-0"	4'-6"	1'-5"	1'-0"	5'-3"	1'-0½"	10'-9"	7'-0"	11.7	1'-0"	5.7
26'-5"	3	9'-0"	4'-6"	1'-5"	1'-0"	5'-3"	10½"	12'-4"	7'-0"	11.7	1'-0"	5.7
29'-5"	3	9'-0"	4'-6"	1'-5"	1'-0"	5'-3"	2'-4½"	12'-4"	7'-0"	11.7	1'-0"	5.7
32'-3"	3	9'-0"	4'-6"	1'-5"	1'-0"	5'-3"	2'-1½"	14'-0"	7'-0"	11.7	1'-0"	5.7
35'-3"	3	9'-0"	4'-6"	1'-5"	1'-0"	5'-3"	3'-7½"	14'-0"	7'-0"	11.7	1'-0"	5.7
38'-1"	4	9'-0"	4'-6"	1'-5"	1'-0"	5'-3"	6½"	12'-4"	7'-0"	15.6	1'-0"	7.6
41'-1"	4	9'-0"	4'-6"	1'-5"	1'-0"	5'-3"	2'-0½"	12'-4"	7'-0"	15.6	1'-0"	7.6
46'-11"	4	9'-0"	4'-6"	1'-5"	1'-0"	5'-3"	2'-5½"	14'-0"	7'-0"	15.6	1'-0"	7.6

11'-0" Diameter Tanks

Length of Tank	Number of Piers	A	B	C	D	E	F	G	H	cu yd Concrete	H	cu yd Concrete
14'-6"	2	9'-6"	4'-9"	1'-6½"	1'-0½"	5'-6"	9"	13'-0"	7'-0"	8.6	1'-0"	4.4
17'-4"	2	9'-6"	4'-9"	1'-6½"	1'-0½"	5'-6"	2'-2"	13'-0"	7'-0"	8.6	1'-0"	4.4
21'-5"	3	9'-6"	4'-9"	1'-6½"	1'-0½"	5'-6"	8½"	10'-0"	7'-0"	12.9	1'-0"	6.6
24'-5"	3	9'-6"	4'-9"	1'-6½"	1'-0½"	5'-6"	2'-1½"	10'-0"	7'-0"	12.9	1'-0"	6.6
27'-3"	3	9'-6"	4'-9"	1'-6½"	1'-0½"	5'-6"	7½"	13'-0"	7'-0"	12.9	1'-0"	6.6
30'-7"	3	9'-6"	4'-9"	1'-6½"	1'-0½"	5'-6"	2'-0½"	13'-0"	7'-0"	12.9	1'-0"	6.6
33'-1"	4	9'-6"	4'-9"	1'-6½"	1'-0½"	5'-6"	1'-0½"	10'-0"	7'-0"	17.2	1'-0"	8.8
35'-11"	4	9'-6"	4'-9"	1'-6½"	1'-0½"	5'-6"	2'-5½"	10'-0"	7'-0"	17.2	1'-0"	8.8
41'-9"	4	9'-6"	4'-9"	1'-6½"	1'-0½"	5'-6"	10½"	13'-0"	7'-0"	17.2	1'-0"	8.8
48'-3"	5	9'-6"	4'-9"	1'-6½"	1'-0½"	5'-6"	3'-7½"	10'-0"	7'-0"	21.5	1'-0"	11.0

For the tank of our example, this becomes:

$$\frac{0.098175\ (252.35)}{10.0625} \times 1728$$

$$= 4260\ \text{in.}^3\ \text{(approx.)}$$

The bending moment M_1, due to weight of water is (a 10 ft diameter tank will hold 587.5 gal per lineal foot, and water weighs 8.33 lb per gal):

$$M_1 = \frac{WL^2}{8} = \frac{587.5 \times 8.33 \times 33 \times 33 \times 12}{8}$$

$$= 8{,}020{,}000\ \text{in. lb (approx.)}$$

where W and L are weight per lineal foot and length, respectively.

The bending moment M_2, due to weight of the steel tank is (circumference of 10 ft 0 in. diameter tank is 31.41 ft and $\frac{3}{8}$ in. steel weighs 15.3 lb per sq ft):

$$M_2 = \frac{WL^2}{8} = \frac{31.41 \times 15.3 \times 33 \times 33 \times 12}{8}$$

$$= 786{,}000\ \text{in. lb}$$

The total bending moment M is therefore approximately 8,806,000 in. lb. Stress in steel due to beam action is found by dividing the bending moment by the section modulus:

$$\text{Stress} = \frac{M}{S} = \frac{8{,}806{,}000}{4260}$$

$$= 2060\ \text{lb per sq in. (approx.)}$$

Stress tending to burst the tank due to the 10 ft head of water acting against the heads of the tank will produce additional tension in the shell, acting in the same direction as that produced by beam action.

Water pressure would vary from zero at the top of the tank to 625 lb per sq ft at the bottom, as water weighs 62.5 lb per cu ft. The average pressure is therefore 312.5 lb per sq ft. The area of the head is 78.54 sq ft. Total pressure on the head will be $78.54 \times 312.5 = 24{,}500$ lb. Since the circumference of the tank in inches is 120×3.14, or 376.8 in., and the thickness of the shell is 0.375 in., the average stress will be $24{,}500 \div (376.8 \times 0.375) = 174$ lb per sq in.

The maximum stress will be twice the average, or 348 lb per sq in. Adding this tension to the 2060 lb per sq in. provided by beam action gives a total of 2408 lb.

Since the allowable working stress in tension is usually taken as about 12,000 lb per sq in., the actual stress produced is relatively small. Pressure other than that due to head of liquid contained in the tank is not considered in this limited discussion of the subject.

FBI COMBATS PLANT SABOTAGE

JOHN EDGAR HOOVER
DIRECTOR

Federal Bureau of Investigation
United States Department of Justice
Washington, D. C.

October 31, 1940

Note last paragraph 2

Associated Business Papers, Inc.
369 Lexington Avenue
New York, New York

Gentlemen:

In the war-torn world of today America must strengthen her internal and external fortifications if she is to survive the menace of totalitarianism. The protection of our industrial facilities to insure the uninterrupted production of goods and material is essential to our national defense. Based upon this premise the FBI in September of 1939, in accordance with the request of the War and Navy Departments, inaugurated a program to survey the protective facilities of manufacturing establishments having large contracts to provide the government with defense materials. The purpose of the surveys is to submit recommendations to bolster the physical protective facilities of the manufacturing plants for the prevention of sabotage and espionage activities.

The first and final responsibility to give speed and strength to our national defense program by protection against espionage and sabotage lies with industry itself. Only through the energy and alertness of its officials and workers will the full measure of preparedness be attained.

In line with this plant survey program and to assist industrial concerns and municipalities in establishing effective protection against possibilities of acts of espionage and sabotage the FBI prepared a comprehensive booklet entitled "Suggestions for Protection of Industrial Facilities." Because of its confidential nature this booklet is limited in distribution to heads of duly constituted law enforcement agencies and executive officials of industrial concerns manufacturing defense materials under government contracts.

In response to the many questions as to how to obtain this publication I wish to state that a copy will be furnished an industrial concern upon the written request of an executive official.

Sincerely yours,

J. Edgar Hoover

John Edgar Hoover
Director

Chain Store Air Conditioning Increases

According to the eighth annual construction study made by the magazine Chain Store Age, the chains spent $7,654,130 for air conditioning in 1940, an increase of 1 per cent over last year. Total expenditure for opening new stores and remodeling old units amounted to $130,101,332 this year, an increase of 3.1 per cent over the record-breaking expenditures for 1939. This is the fourth successive year of the survey in which air conditioning expenditures reported by the chains have exceeded $7,500,000 annually.

The consistency with which chains are carrying on air conditioning programs is indicated by the fact that this year they spent on air conditioning 5.9 per cent of the total for store modernization, and last year they spent 6 per cent of the total modernization expenditure on air conditioning, Chain Store Age points out.

Consistency is also shown by the relationship between number of stores air conditioned and number of stores modernized (including new stores opened and old stores remodeled. This year the number of stores air conditioned equaled 12.3 per cent of the number of stores modernized. Last year the figure was 13 per cent, and in 1938 it was 12 per cent.

Reports in six fields showed that 2 per cent of all stores were air conditioned.

Air Duct Friction Chart

Harold S. Morton, Sutherland Air Conditioning Co.,

Presents Chart for Solving Problems in Duct Design

SUMMARY

Mr. Morton recently drew up the alignment chart shown on the next page to permit the rapid solution of problems in duct design. The data by which ducts are designed usually must be obtained from several different sources; Mr. Morton has put it all on the single chart he presents here—friction, velocity, cfm, diameter of round duct, width and depth of equivalent rectangular duct, friction loss in turns, etc. . . . . Use of the chart is explained in the text and is illustrated by the dotted lines on the chart. . . . . A number of engineers have been using this chart in blueprint form, and are enthusiastic about it. Students at the University of Minnesota have compared it with previously published data and use it in class

THE air friction data by means of which duct work is designed are usually obtained from several different sources, necessitating reference to a number of different charts and tables. The writer has therefore assembled all the necessary information on the single air duct friction chart which is reproduced on the next page. Engineers who do a considerable amount of duct layout work have found it to be a great time-saver, and to be so easy to read that the likelihood of errors is greatly reduced.

Before using the chart, it is customary to rough out a line drawing of the proposed duct work and mark down the cfm passing through each section.

In order to use the chart, a transparent ruler or triangle is laid across the chart covering scales I-VII inclusive. It is necessary to establish two points on separate scales in order to define conditions in any specific piece of duct work. Cfm is, of course, one determining point, and we may arbitrarily assume the air velocity for the second. Having thus established a line on the chart, we can read on scale I the friction in inches of water per hundred feet of straight duct; and on scale II, the velocity head in inches of water. Scale III marks the velocity which was assumed in establishing the line. (*Do not read scale IV on this line.*) Scale V marks the cfm assumed in establishing this line. On scale VI we read the number of feet of straight pipe in which the friction loss is equal to one velocity head; and on scale VII we read the diameter of round duct which will handle the given cfm at the assumed velocity with the indicated friction loss per hundred feet.

It will be noted that any line laid across the six scales fully defines all conditions relating to the movement of a given quantity of air in a given size of duct.

Scales IV, VII and VIII are used for determining the rectangular duct with friction per hundred feet equivalent to any round duct. Using the diameter of the round duct as shown on scale VII as a turning point, a line drawn across scales IV, VII and VIII will show the width and depth of the rectangular duct on scales IV and VIII.

At the lower left, the friction in right angle turns is shown for both round and rectangular ducts. The friction depends on the radius of curvature and is expressed as a percentage of the velocity head. By taking the indicated percentage of the velocity head as read on scale II, we determine the friction loss in the turn in inches of water, or by taking the indicated percentage of the reading on scale VI, we determine the equivalent linear feet of straight duct having a resistance equal to that of the turn.

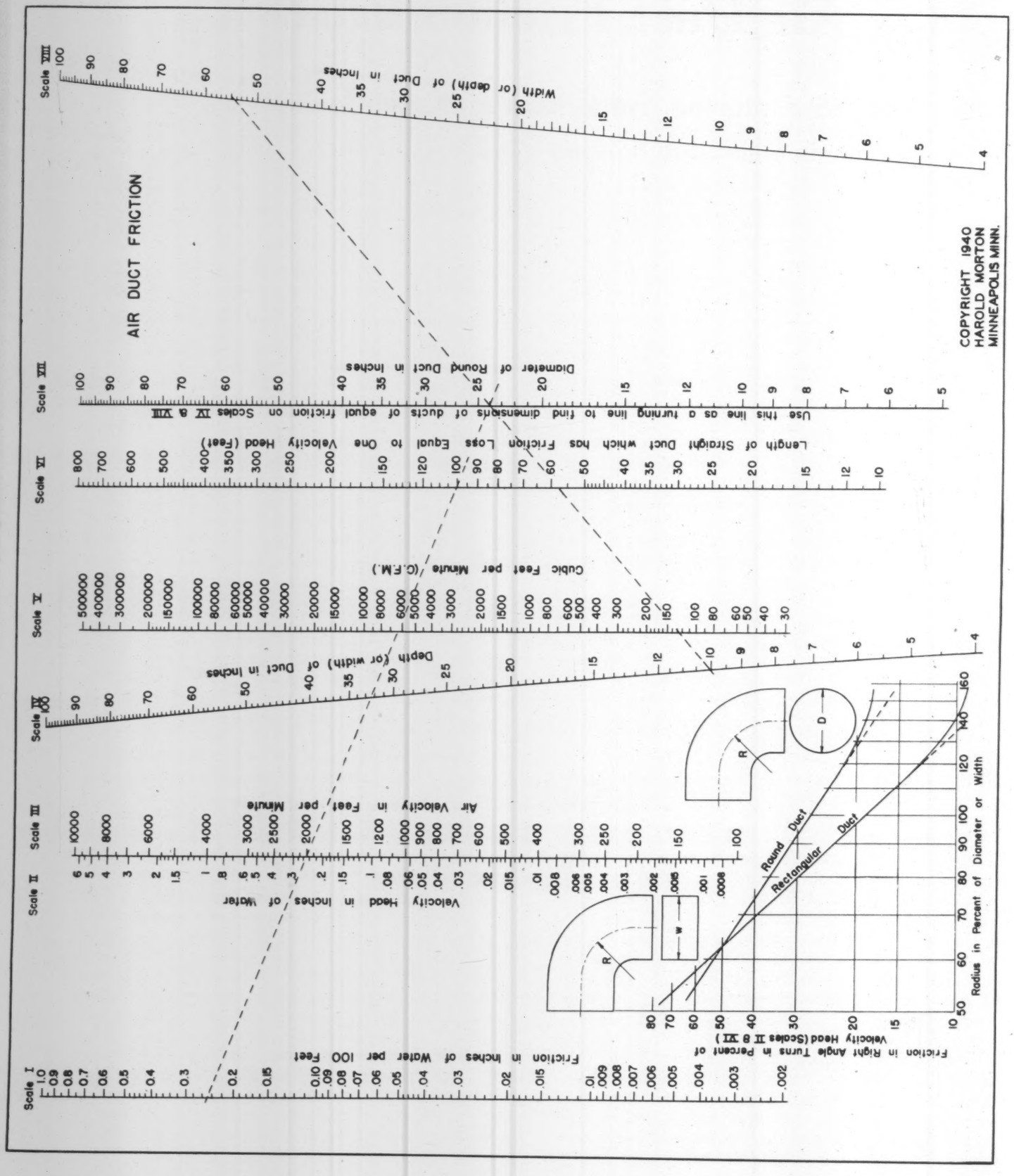
It is sometimes desirable to design various portions of a system of duct work on an equal friction basis. In order to do so, it is only necessary to select a point on scale I and align it successively with the several cfm values on scale V. Each line thus established will determine the velocity and the size of the required section of duct.

It is equally convenient to use this chart in checking back on existing duct work. Scales IV, VII and VIII quickly determine the round equivalent of any piece of duct work. The point thus established on scale VII can be joined to a required cfm to show immediately the velocity and friction; or it can be joined to an assumed velocity to show the resulting friction and cfm; or can be joined to a permissible friction value and show velocity and cfm.

One of the greatest values of using such a chart lies in the ease with which readjustments can be made when it becomes obvious that the original design assumptions do not work out to the best advantage. When using slow and cumbersome methods or calculations, a person is disinclined to recalculate a job unless it is absolutely necessary, but when using a rapid calculation, if one finds that the assumed velocity gives too high a friction value, it is merely necessary to swing the line around until a satisfactory set of values is found. Anything which speeds up the process of carrying out routine computations and which is susceptible to re-checking or readjusting tends to increase accuracy and to improve the standard of engineering work.

Air Duct Friction Chart

[See instructions for use on preceding page]


AIR DUCT FRICTION
COPYRIGHT 1940
HAROLD MORTON
MINNEAPOLIS MINN.
Scale VIII
Width (or depth) of Duct in Inches
Scale VII
Diameter of Round Duct in Inches
Use this line as a turning line to find dimensions of ducts of equal friction on Scales IX & VIII
Scale VI
Length of Straight Duct which has Friction Loss Equal to One Velocity Head (Feet)
Scale V
Cubic Feet per Minute (C.F.M.)
Scale IV
Depth (or width) of Duct in Inches
Scale III
Air Velocity in Feet per Minute
Scale II
Velocity Head in Inches of Water
Scale I
Friction in Inches of Water per 100 Feet
Friction in Right Angle Turns in Percent of Velocity Head (Scales II & VI)
Radius in Percent of Diameter or Width
Round Duct
Rectangular Duct
R
D
W

Heating · Piping and Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

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Summer Cooling in the Research Residence with a Gas-Fired Dehydration Cooling Unit

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Urbana, Illinois

This paper is the result of research sponsored by the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS and the *American Gas Association* conducted in the Research Residence of the *National Warm Air Heating and Air Conditioning Association* and the University of Illinois.

SUMMARY

Investigation of the operating characteristics of a summer cooling unit was carried on in the Research Residence during the Summer of 1940, and data were collected for continuous and intermittent operation of the gas fired dehydration plant. Operating methods at various effective temperatures were studied and results indicate the necessity for further study of methods of calculating moisture load. The effect of insulation in the ceiling and side walls of a building was also studied

DURING the summers of 1932 to 1938 inclusive, extensive studies on summer cooling in the Research Residence have been conducted with the use of ice as a medium for cooling water circulated through cooling coils, with water at three different temperatures used directly through cooling coils, and with mechanical condensing units expanding the refrigerant directly into cooling coils. In the course of the investigations two different sizes of condensing units were used, and studies were made both with and without introducing cool outdoor air into the house at night. These studies on summer cooling were extended in 1940 to include the performance and operating characteristics of a gas-fired, dehydration, cooling unit.

Description of Cooling Equipment

The Research Residence together with the forced-air heating system has been described in previous publications.[1,2] During the summer of 1939 the exposed sidewalls and ceilings of the Residence were fully insulated with mineral wool. The calculated cooling load for the structure based on design conditions of 95 F outdoor dry-bulb temperature, 76 F outdoor wet-bulb temperature, 80 F indoor dry-bulb temperature, 50 per cent indoor relative humidity, and one air change per hour brought in for ventilation, amounted to 25,300 Btu per hour. Similarly, the calculated cooling load for the uninsulated structure was 37,500 Btu per hour. Hence, by completely insulating the Residence the calculated cooling load was reduced from 37,500 Btu per hour to 25,300 Btu per hour or a reduction of 32.5 per cent.

The total space cooled, consisting of the first and second stories of the Residence, amounted to 14,170 cu ft.

The arrangement of the distributing ducts and fan in the forced-air system was similar to that used in previous investigations.[3] Fig. 1 shows the plan and Fig. 2 shows the elevation of the cooling unit

[3]Loc. cit. Notes 1 and 2.

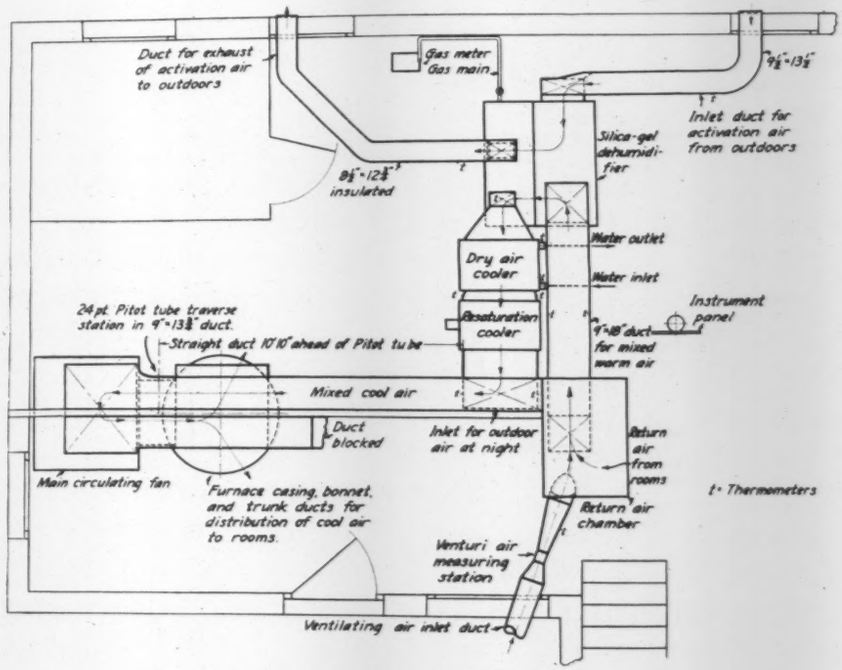
Duct for exhaust of activation air to outdoors
Gas meter
Gas main
Inlet duct for activation air from outdoors
Silica-gel dehumidifier
insulated
Water outlet
Dry air cooler
Water inlet
Instrument panel
24 pt. Pitot tube traverse station in duct.
Straight duct ahead of Pitot tube
Mixed cool air
Duct blocked
Inlet for outdoor air at night
Return air from rooms
Main circulating fan
Furnace casing, bonnet, and trunk ducts for distribution of cool air to rooms.
Thermometers
Return air chamber
Venturi air measuring station
Ventilating air inlet duct

Fig. 1—Plan of cooling plant and duct arrangement

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[1]ASHVE Research Report No. 1034—Study of Summer Cooling in the Research Residence Using Water from the City Water Mains, by A. P. Kratz, M. K. Fahnestock, S. Konzo, and E. L. Broderick. (ASHVE TRANSACTIONS, Vol. 42, 1936, p. 193.)
[2]Investigation of Summer Cooling in the Warm-Air Heating Research Residence, by A. P. Kratz, M. K. Fahnestock, and S. Konzo. (University of Illinois Engineering Experiment Station Bulletin 290, January 1937.)
For presentation at the Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Kansas City, Mo., January 1941.

and connected ducts. On the suction side of the circulating fan provision was made for taking in 1500 cfm of air from outdoors at night. The cooling unit was composed of three separate parts, namely the gas-fired silica-gel dehumidifier, the dry air cooler, and the resaturation cooler. As shown in Fig. 3, in the first stage of the cooling and dehumidification process the recirculated air entering the stair grille joined with the ventilating air from outdoors and the resulting mixed warm air entered the dehumidifier. This air in passing through the silica-gel contained in the rotating drum, located in the dehumidifier, was dried and heated by adsorption. The silica-gel in the rotating drum was continuously reactivated, and the moisture was taken up by the activation air brought in from outdoors. The heat required for this process was supplied by a gas burner supplementing the heat contained in the activation air.

In the second stage the heated dry air leaving the dehumidifier passed through the dry air cooler, or water cooled coil, and the dry-bulb temperature was reduced from about 130 F to 78 F.

In the final stage of the cooling process the air leaving the dry-air cooler was subjected to evaporative cooling in the resaturation cooler, resulting in a decrease in dry-bulb temperature and an increase in moisture content. The resaturation cooler contained a rotating wet screen through which the air was passed.

The conditioned air, which was materially cooler and dryer than the air entering the cooling unit, then passed through the furnace casing into the ducts of the air distribution system and was delivered out of the registers into the rooms to be cooled. A typical flow diagram, giving the temperatures and humidities at each stage of the cooling process, is shown in Fig. 3.

It may be observed from the values given in Fig. 3 that the final temperature and humidity of the conditioned air were directly dependent upon whether or not the resaturation cooler operated. When the resaturation cooler was in operation the dry-bulb temperature of the air leaving the cooling unit was about 64 F and the moisture content was about 62 gr (grains) per pound

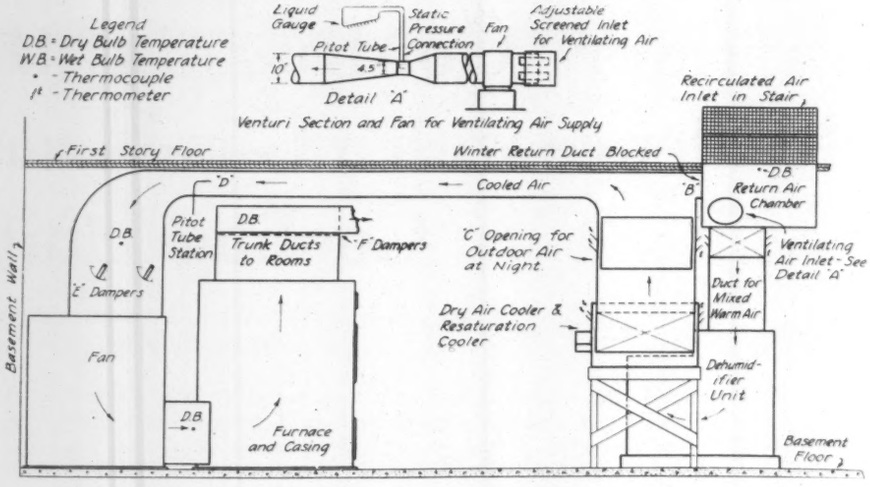

Fig. 2—Elevation of cooling plant and duct arrangement

of dry air. However, when the resaturation cooler was not in operation, the dry-bulb temperature of the air leaving the cooling unit was about 78 F and the moisture content was about 47 gr per pound of dry air. Hence, by operating the resaturation cooler in conjunction with both the dehumidifier and the dry air cooler, very cool but somewhat dry air was obtained as an end product, whereas by operating only the dehumidifier and the dry air cooler, slightly cool but very dry air was obtained.

To a limited extent it was possible to control the humidity of the air in a given space independently of the dry-bulb temperature. In this connection it is of interest to note that with either the mechanical condensing unit or with water cooled coils, the humidity maintained in the house was primarily dependent on the temperature of the cooling coil,[4] and it would not have been possible to obtain independent control of the humidity and air temperature without resorting to some form of reheating.

The automatic control system which coordinated the operation of the resaturation cooler with that of the dehumidifier and dry air cooler included a room thermostat and room humidistat, both of which were located in the second story hall. A simplified wiring diagram of the control system is shown in Fig. 4. The four possible combinations of temperatures and humidities of the air that might occur in the Residence and the manner in which the controls would respond in each case are listed in Table 1. For example, as shown in case *A* in Table 1, when the dry-bulb temperature was higher than the setting of the room thermostat and at the same time the relative humidity was higher than the setting of the room humidistat, all three elements of the cooling unit would be brought into operation.

For the purpose of these tests the temperature of the water supplied to the coils in the dry air cooler was maintained at 75 F which was representative of water temperatures commonly available. Since the temperature of the local water supply was about 58 F, considerable auxiliary equipment shown in Fig. 5, which would otherwise have been unnecessary, was required in order to furnish approximately 300 gal of water per hour supplied to the dry air cooler at a temperature of 75 F.

Method of Conducting Tests

Continuous records were made during the summer of the temperatures of the air in the various parts of the house and of the outdoor air. During the periods of operation, observations were made of the quantity and temperatures of the water passing through the dry air cooler, the gas consumption in the dehumidifier, and the electrical inputs to the motors operating the cooling unit and the circulating fan. Observations were also made of the temperatures and humidities of the air in various sections of the duct system and in the house.

[4]Summer Cooling in the Warm-Air Heating Research Residence with Cold Water, by A. P. Kratz, S. Konzo, M. K. Fahnestock, and E. L. Broderick. (University of Illinois Engineering Experiment Station Bulletin 305, p. 44, August 1938.)

During all of the tests the windows in the attic remained open, and those on the first story remained closed. The recirculated air was returned through the return air grille located in the stair risers in the first story hall. With the exception of one series of tests (*Series 4-40*), artificial cooling during the day was supplemented by cooling with outdoor air at night. For this purpose the attic door and 11 windows on the second story were opened in the evening when the effective temperature outdoors became equal to that indoors. At this time the basement door was opened and the dampers were set so that the fan delivered outdoor air, equivalent to 6.4 air changes per hour, through the duct system to both stories. With one exception, air from outdoors was thus supplied until 7:00 a.m., when the windows and doors were closed, the dampers were reset, and the fan was stopped. In *Series 2-40* outdoor air was supplied only up to 6:00 a.m. instead of 7:00 a.m.

When the cooling unit was in operation, the total quantity of air delivered by the circulating fan was 804 cfm, equivalent to 3.4 air changes per hour. Of this amount, 232 cfm, equivalent to one air change per hour, represented the outdoor air admitted for ventilation.

The Residence was operated strictly on the schedules described in connection with the following discussion of the different test series:

Constant Effective Temperature. Cooling Supplemented by Outdoor Air at Night. (*Series 2-40*). In this series of tests, cooling with outdoor air at night was stopped at 6 a.m. During the period between 6 a.m. and the start of the test the recirculating and ventilating fans were not operated. When the effective temperature in the house rose to 74 deg the cooling unit was manually started. The ventilating fan was also started and was operated during the entire period of the test. Before the cooling unit was started, the prevailing relative humidities ranged from 60 to 75 per cent, and at the time of starting, the indoor dry-bulb was between 77 and 78 F. Conditions at the start of the test thus usually corresponded with case *C* shown in Table 1. After the start of the test the cooling unit was operated automatically by the controls. The room thermostat was set to maintain 80 F dry-bulb temperature and the room humidistat to maintain 50 per cent relative humidity, corresponding to an effective temperature of approximately

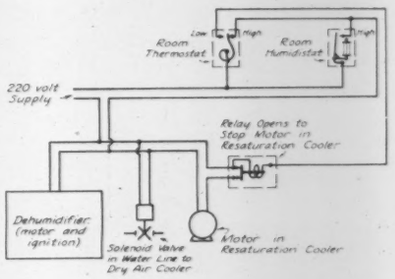

Fig. 4—Simplified wiring diagram for cooling plant

74 deg. When the cooling plant operated intermittently both the main circulating fan and the cooling unit were started and stopped at the same time.

Constant Dry-Bulb Temperature. Cooling Supplemented by Outdoor Air at Night. (*Series 3-40*). Cooling with outdoor air at night was stopped at 7:00 a.m. This series differed from *Series 2-40* in that the tests were not started until the dry-bulb temperature rose to 81 F instead of to a dry-bulb temperature corresponding with an effective temperature of 74 deg. The cooling unit was started manually and thereafter the room thermostat and humidistat maintained a dry-bulb temperature of approximately 80 F and a relative humidity of approximately 50 per cent. With the exception of a few minor details of operation, these tests were exactly comparable with those in *Series 3-34* previously conducted[5] in the uninsulated house, and for which a mechanical condensing unit was used.

Constant Effective Temperature. Cooling Not Supplemented by Outdoor Air at Night. (*Series 4-40*). For this series of tests no cooling was done with outdoor air at night. The house remained closed day and night and the plant was started when the indoor effective temperature rose to 74 deg, after which it operated automatically with the room thermostat set at 80 F and the humidistat set at 50 per cent relative humidity. Outdoor air for ventilating purposes amounting to one air change per hour was introduced into the house both day and night.

Low Relative Humidity. (*Series 5-40.*) During a 48 hour period of

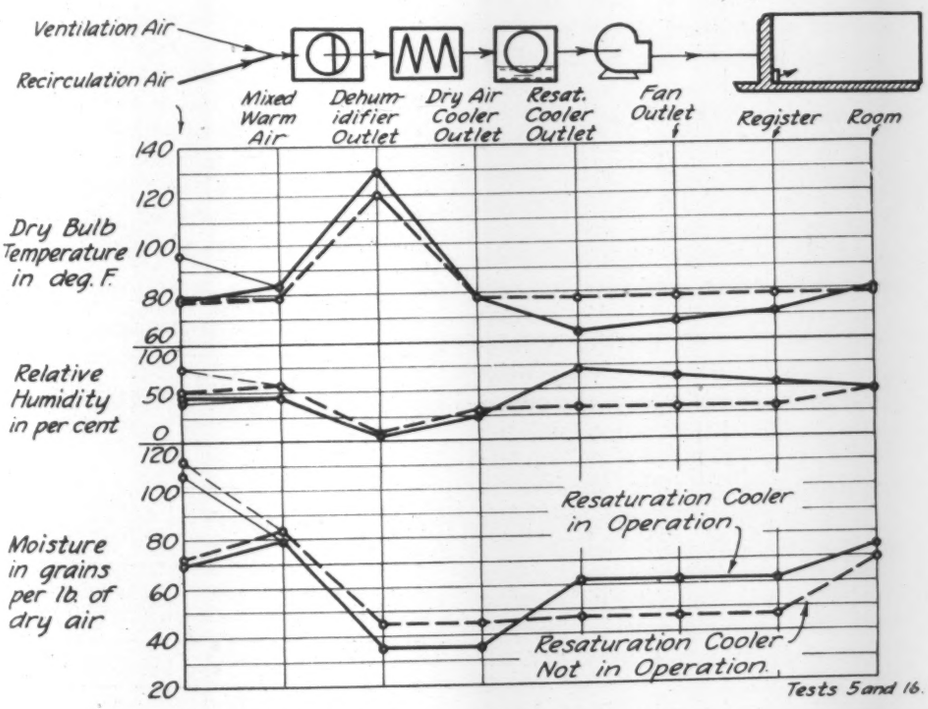

Fig. 3—Flow diagram for air passing through cooling system

[5]Loc. cit. Note 2.

hot weather the plant was operated with the controls set to maintain approximately 83 F and 30 per cent. The plant was started when the indoor effective temperature rose to 74 deg and was operated automatically by the controls during the test period.

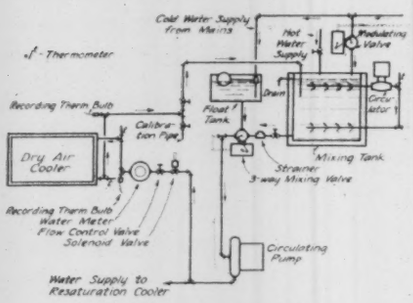

Fig. 5—Auxiliary equipment for maintaining temperature of water to dry air cooler

Results of Tests

Constant Dry-Bulb Temperature. Cooling Supplemented by Outdoor Air at Night. (Series 3-40.) The tests comprising *Series 3-40* were made in the insulated structure under operating conditions duplicating as closely as possible those maintained for the tests made in 1934, at which time a mechanical condensing unit was used to cool the uninsulated structure. As far as comfort is concerned, this method of operation was subject to the same limitations as those observed in connection with the tests made with mechanical refrigeration and with water, which have been discussed in previous publications.[6] General data and results from all of the tests made in 1940 are shown in Table 2.

The operating characteristics of the cooling plant can best be illustrated by the results obtained on a typical day. For this purpose the test made on August 14, 1940, was selected as typical of the operation obtained on a warm day, and the results are shown in the first column of Table 3 and in Fig. 6. The data presented in the table were obtained at 6:10 p.m., at which time only the dehumidifier and dry air cooler were operating. On mild and medium warm days long periods of time frequently occurred during which very little cooling was necessary, and the action of the dehumidifier and dry air cooler was sufficient to maintain the required dry-bulb temperature in the house without being supplemented by that of the resaturation cooler.

The air conditions at different locations are given in items 5 to 17. The temperature of the air leaving the registers was approximately 78.3 F and the rise in temperature of the air in passing through the furnace casing and ducts was 0.8 F. Of the total amount of heat removed from the air (Item 22), only 4 per cent represented the heat absorbed in reducing the dry-bulb temperature and 96 per cent represented the heat absorbed in removing the water vapor.

As shown in Fig. 6, outdoor air had been circulated through all the rooms of the house from 9:15 p.m. to 7:00 a.m. during the night previous to the test. At 7 a.m. the windows on the second story were closed and the basement fan was stopped. By 2:30 p.m. the temperature on the second story had increased to 81 F and the cooling unit was started. During the period from 2:30 p.m. to 7:50 p.m. the cooling plant operated intermittently to maintain the dry-bulb temperature on the second story at about 80 F and the relative humidity at about 50 per cent. At 7:50 p.m., when the outdoor effective temperature became lower than the indoor effective temperature, the windows on the second story were opened and the cooling with outdoor air at night was begun.

With the types of cooling plants used in previous years, on days during which the plant operated intermittently, a period at the start of the test and the off-periods were accompanied by relatively high humidities which were not conducive to comfort. With the dehydration cooling unit used in 1940, the rise in relative humidity during the off-periods was limited by means of the operation of the dehumidifier, and the comfort conditions during the off-periods were entirely satisfactory. At the beginning of each test, however, the high relative humidities and effective temperatures existing prior to and immediately following the start were accompanied by comfort conditions that were not entirely satisfactory during those periods. As shown by Fig. 6, introduction of cool humid air during the night resulted in an indoor relative humidity of 69.5 per cent at 7 a.m. Prior to the start of the cooling unit the relative humidity decreased from 69.5 per cent to 65.5 per cent, and the effective temperature rose from 73.6 deg at 7 a.m. to 76.1 deg at 2:30 p.m. while the dry-bulb temperature rose from 77.3 F to 80.4 F. Thus, for a period of about four hours previous to and ½ hour subsequent to the start of the test the indoor effective temperature exceeded 75 deg which has been considered as the upper border line for comfort.

Constant Effective Temperature. Supplemented by Cooling with Outdoor Air at Night. (Series 2-40.) The initial period of effective temperatures exceeding the upper limit of comfort, occasioned by delaying the starting of the cooling unit until the dry-bulb temperature on the second story rose to 81 F, could be eliminated by starting the plant earlier, thus bringing the dehumidifier and dry air cooler into operation, when the effective temperature rose to 74 deg. Thereafter, the cooling unit was operated with the thermostat set to maintain 80 F and the humidistat set to maintain 50 per cent relative humidity. The series of tests made under these conditions has been designated as *Series 2-40.* The results obtained on two typical hot days are shown in Fig. 7. The test made on July 24, 1940, was preceded by supplementary cooling with outdoor air at night. However, owing to the fact that during the night of July 24 the outdoor effective temperature never dropped below 74 deg, cooling was continued without opening the windows, and the test of July 25 was

Table 1—Control of Cooling Unit by Thermostat and Humidistat

Case	Room Temperature Relative to Thermostat Setting	Room Humidity Relative to Humidistat Setting	Parts of Cooling Unit in Operation
A	High	High	1. Dehumidifier 2. Dry Air Cooler 3. Resaturation Cooler
B	High	Low	1. Dehumidifier 2. Dry Air Cooler 3. Resaturation Cooler
C	Low	High	1. Dehumidifier 2. Dry Air Cooler
D	Low	Low	None

[6]University of Illinois Engineering Experiment Station Bulletins Nos. 290 and 305, pp. 100 and 41 respectively.

Table 2—Complete Data and Results for Tests—1940

Date 1940	Test No.	Series No.	Weather Data: Degree Hours Above 80 F	Degree Hours Above 85 F	Degree Hours Above 90 F	Total Sunshine in Hours and Min.	Outdoor Air: Maximum Temp. During Test, F	Minimum Temp. Previous to Test, F	Avg. During Period Requiring Cooling: Temp. F	Avg. During Period Requiring Cooling: Hum., Per Cent	Indoor Air Conditions: At End of Night Cooling: Temp. F	At End of Night Cooling: Hum., Per Cent	Avg. During Period Requiring Cooling: Temp. F	Avg. During Period Requiring Cooling: Hum., Per Cent	Temperature Difference: Outdoor Max. to Avg. Indoor F	Temperature Difference: Avg. Outdoor to Avg. Indoor F	Operation of the Fan: Night Air Cooling Previous to Test Period: Duration Hours	Night Air Cooling Previous to Test Period: Power Kwhr.	Recirculation During Test Period: Duration Hours	Recirculation During Test Period: Power Kwhr.	Overall Test Period: Start of Cooling with Dehydration Unit to Start of Night Air Cooling: Start	Start of Cooling with Dehydration Unit to Start of Night Air Cooling: End	Overall Test Period: Duration Hours	Dehumidifier and Dry Air Cooler Operation: Time in Hours	Power Input Kwhr.	Gas Input Cu. Ft.	Cooling Water: Quantity in Gallons	Cooling Water: Inlet Temperature	Cooling Water: Temperature Rise	Re-saturator Operation, Hours	Total Moisture Removed Lb.	Heat Absorbed by Cooling Plant During Overall Test Period Btu.: Load Due to Moisture	Heat Absorbed by Cooling Plant During Overall Test Period Btu.: Sensible	Heat Absorbed by Cooling Plant During Overall Test Period Btu.: Total	Ratio Moisture to Total Load
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
7–21	1	2–40	75.8	29.5	4.3	13:09	92	66	86.2	56.3	76.6	66.4	80.4	48.8	11.6	5.8	12.00	7.0	6.68	5.8	10:12a	7:50p	9.63	6.68	4.7	630	1899	75.1	14.8	4.66	94.5	104,600	72,800	177,400	0.590
7–22	2	2–40	80.0	31.2	4.3	14:39	92	68	85.9	55.3	78.4	75.4	80.5	49.2	11.5	5.4	11.83	7.3	5.42	3.2	8:26a	8:41p	12.25	5.42	3.8	530	1439	74.8	17.0	0	114.4	125,600	16,500	142,100	0.884
7–23	3	2–40	98.5	41.5	6.3	14:38	93	71	85.4	56.8	78.8	72.3	79.9	47.4	13.1	5.5	9.92	5.8	15.27	9.0	7:08a	11:40p	16.53	15.27	10.9	1465	4602	75.1	14.6	12.60	173.9	192,900	192,800	385,700	0.500
7–24	4	2–40	148.2	84.5	32.5	14:36	97	73	84.9	62.2	79.6	71.6	79.9	50.2	17.1	5.0	6.33	3.7	23.90	14.1	6:00a	6:00a	24.00	23.90	16.7	2405	7035	75.0	15.3	23.90	241.4	271,300	336,700	608,000	0.446
7–25	5	2–40	191.0	110.2	52.3	14:34	99	75	86.9	53.4	—	—	80.4	46.1	18.6	6.5	—	0	23.98	14.3	6:00a	6:00a	24.00	23.98	16.5	2280	7215	74.9	15.1	23.98	227.8	254,800	362,700	617,500	0.413
7–26	6	2–40	145.9	76.4	23.5	14:32	96	76	88.1	53.5	—	—	80.6	44.8	15.4	7.5	—	0	17.15	10.2	6:00a	11:10p	17.17	17.15	11.7	1650	5180	75.0	15.0	17.15	166.3	185,500	266,800	452,300	0.410
7–27	7	2–40	92.8	39.3	8.0	10:31	93	72	84.9	54.2	79.1	71.0	79.5	50.3	13.5	5.4	7.00	4.0	15.80	9.5	6:10a	10:00p	15.83	15.80	11.0	1540	4691	75.2	15.1	15.80	151.7	170,400	221,100	391,500	0.435
7–28	8	2–40	161.0	92.5	38.8	14:28	97	73	88.3	60.5	78.9	71.8	79.9	50.7	17.1	8.4	8.00	4.5	17.47	10.4	6:00a	11:30p	17.50	17.47	12.2	1660	5229	75.5	15.3	17.47	173.0	192,300	261,200	453,500	0.424
7–29	9	5–40	161.2	96.0	43.3	14:26	98	75	84.5	59.9	79.9	71.1	82.3	34.5	15.7	2.2	6.50	3.7	16.38	9.1	6:00a	6:00a	24.00	16.38	10.5	1530	4975	75.2	13.9	0	298.1	328,600	75,400	404,000	0.813
7–30	10	5–40	124.2	68.8	27.0	11:31	97	72	88.0	52.8	—	—	82.6	32.9	14.4	5.4	—	0	10.50	6.0	6:00a	6:42p	12.70	10.50	6.9	970	3138	75.1	15.0	4.90	140.0	156,200	119,500	275,700	0.567
7–31	11	3–40	54.5	16.5	0	14:22	90	71	85.0	48.5	79.7	70.6	79.8	48.6	10.2	5.2	11.30	6.5	11.00	6.4	6:00a	7:27p	13.45	11.00	7.6	1050	3387	75.2	14.1	11.00	94.6	106,200	165,500	271,700	0.391
8–3	12	3–40	138.5	77.1	30.7	14:16	97	65	81.2	56.3	75.4	57.3	79.1	54.2	17.9	2.1	12.00	7.0	10.13	5.9	:15p	7:00a	14.75	10.13	7.0	990	3014	75.4	14.9	9.30	83.7	93,500	135,300	228,800	0.409
8–4	13	3–40	36.5	3.0	0	10:58	89	72	81.5	62.8	—	—	79.4	53.2	9.6	2.1	—	0	11.50	6.8	7:00a	9:30p	14.50	11.50	7.8	1120	3501	75.3	14.9	9.83	148.6	164,300	143,900	308,200	0.533
8–5	14	3–40	65.0	27.0	8.3	10:21	94	71	82.9	58.5	77.8	77.7	79.6	56.1	14.4	3.3	9.50	5.6	2.43	1.5	2:00p	5:55p	3.92	2.43	1.8	260	774	75.3	14.1	1.83	37.5	41,300	25,400	66,900	0.620
8–13	15	3–40	84.3	35.5	6.8	8:00	93	71	84.5	62.2	76.8	70.5	79.3	55.0	13.7	5.2	10.50	6.3	3.05	1.8	4:15p	9:15p	5.00	3.05	2.1	310	890	75.1	16.2	1.83	50.4	55,600	25,900	81,500	0.682
8–14	16	3–40	73.5	37.8	10.5	9:12	96	69	79.7	72.8	77.2	69.3	79.2	54.0	16.8	0.5	9.75	5.8	2.80	1.8	2:30p	7:55p	5.42	2.80	2.0	290	822	75.2	14.5	1.08	44.3	48,800	15,300	64,100	0.761
8–15	17	3–40	65.0	26.0	5.0	13:50	92	69	81.4	55.0	76.5	69.6	79.3	51.9	12.7	2.1	11.08	6.4	2.25	1.5	4:45p	7:30p	2.75	2.25	1.7	220	675	75.6	16.0	1.78	30.9	34,400	24,400	58,800	0.585
8–16	18	3–40	111.0	54.3	16.5	13:32	96	70	86.8	51.3	77.4	79.8	79.4	51.8	16.6	7.4	11.50	6.8	5.50	3.3	3:00p	10:30p	7.50	5.50	3.8	540	1649	75.2	15.2	5.00	58.6	65,300	75,600	140,900	0.463
8–17	19	3–40	110.0	55.8	20.5	11:59	96	71	87.3	47.0	78.1	66.0	79.6	51.0	16.4	7.7	8.50	5.2	8.42	4.9	12:45p	10:00p	9.25	8.42	5.9	810	2482	75.2	15.3	8.42	67.4	75,100	127,300	202,400	0.371
8–29	20	4–40	2.5	0	0	10:48	82	67	80.3	53.3	—	—	77.0	53.6	5.0	3.3	—	0	1.49	0.6	2:30p	5:10p	2.67	1.49	1.0	140	444	75.2	14.0	0	31.0	33,800	0	33,800	1.000

not accompanied by supplementary cooling with outdoor air on the preceding night. The data shown in the second column of Table 3 were obtained on July 25, 1940, at 2:00 p.m. at which time the dehumidifier, the dry air cooler, and the resaturation cooler were all operating. The heat represented by the extraction of water vapor was in this case 36.1 per cent of the total amount of heat removed from the air. (Item 22.)

As shown in Fig. 7 the cooling unit operated continuously over a period beginning at 6:00 a.m. on July 24, 1940, and extending beyond 6:00 a.m. on July 26. During the entire test period the effective temperature was maintained between 72.5 deg and 74.5 deg and the comfort conditions were entirely satisfactory. On milder days than those shown in Fig. 7 the cooling plant operated intermittently with equally satisfactory results. The increase in comfort resulting from starting the cooling unit when the effective temperature rose to 74 deg, instead of starting the cooling unit when the dry-bulb temperature on the second story rose to 81 F, was accompanied by an increase in the total time of operation per day.

Constant Effective Temperature. Cooling Not Supplemented by Outdoor Air at Night. (*Series 4-40.*) Qwing to the fact that the advantage of supplementary cooling with outdoor air at night is sometimes discounted, and the continuous use of air conditioning without the admission at any time of outdoor air in excess of ventilation requirements is advocated, a series of tests under the latter conditions was run. It may be noted that by operating in this manner (*Series 4-40*), certain periods were covered during which outdoor air at night would have been feasible, while on other warm nights the outdoor effective temperature did not become less than that indoors before midnight, and no air from outdoors would normally have been introduced. In the latter case *Series 2-40* and *3-40* would have merged into *Series 4-40* as illustrated by the test made on July 25, 1940, and shown in the right hand portion of Fig. 7.

Tests included in *Series 4-40* were made with the windows on the first and second stories in the Residence closed day and night, irrespec-

tive of outdoor temperatures, and with the ventilating fan operating continuously to supply outdoor air equivalent to one air change per hour. The indoor effective temperature was automatically maintained at approximately 74 deg. Occasionally, in very mild weather, operation of the dehumidifier and dry air cooler alone resulted in an effective temperature approaching 72 deg even though the relative humidity did not drop materially below 50 per cent. In these cases the plant was stopped manually for short periods of time. The comfort conditions were satisfactory, and the variations in relative humidities were not large.

On warm, humid nights the contrast between the indoor and outdoor air conditions is such that there would be no objection to keeping the windows closed and depending upon the cooling unit to maintain the desired indoor temperature and humidity. On such nights the advantage of this method of operation is unquestionable. Furthermore, from the tests made with cooling during the day supplemented by cooling with outdoor air at night, as shown in Fig. 6 and in the left hand portion of Fig. 7, it is evident that the introduction of outdoor air into the house at night always resulted in a high indoor humidity. After the house was closed in the morning and the cooling plant was started, the dehumidifier operated at full load for a considerable time before the indoor humidity was brought back to normal at about 50 per cent. Hence, on comparatively warm nights, the advantage effected by the introduction of outdoor air at night, as measured by the reduction of the indoor dry-bulb temperature, was offset by the rise in relative humidity.

However, many nights occur during which the outdoor temperature is sufficiently lower than the indoor temperature, so that, if an effective means of cooling with outdoor air at night is available, the advantage represented by lowering the indoor temperature more than offsets the disadvantage resulting from the increase in indoor humidity. Under these conditions cooling by means of outdoor air at night is justifiable, even though such supplementary cooling involves the labor of opening and closing the windows each

Table 3—Typical Operating Data and Results

Item	1	2	3
1. Date	8–14–40	7–25–40	7-29-40
2. Test Number	16	5	9
3. Series	3–40	2–40	5–40
4. Time of Day	6:10 p	2:00 p	2:00 p
5. Outdoor Air			
Dry Bulb, deg. F	76.0	97.0	98.0
Wet Bulb, deg. F	71.7	74.9	78.5
Dew Point, deg. F	69.9	65.6	71.3
Relative Humidity, per cent	81.0	34.5	41.0
Specific Humidity, grains per pound dry air	109.8	94.3	115.5
6. Indoor Air, average breathing level temperature			
1st story, deg. F	78.0	80.0	81.4
2nd story, deg. F	79.4	81.8	82.0
7. Indoor Air average at breathing level			
Dry Bulb, deg. F	78.7	80.9	81.7
Wet Bulb, deg. F	65.0	66.7	59.9
Dew Point, deg. F	57.4	59.2	44.1
Relative Humidity, per cent	47.3	46.8	25.8
Specific Humidity, grains per pound dry air	70.0	74.9	42.2
8. Indoor Air entering return grille			
Dry Bulb, deg. F	77.5	79.1	80.3
Wet Bulb, deg. F	65.0	65.1	60.2
Dew Point, deg. F	58.1	57.3	45.8
Relative Humidity, per cent	50.5	46.5	29.0
Specific Humidity, grains per pound dry air	72.0	69.8	45.3
9 Ventilating Air			
Dry Bulb, deg. F	79.0	96.1	95.5
Wet Bulb, deg. F	72.9	76.6	75.4
Dew Point, deg. F	70.4	68.9	67.2
Relative Humidity, per cent	74.7	40.0	38.5
Specific Humidity, grains per pound dry air	111.8	106.1	99.8
10. Mixed Air, entering Dehumidifier			
Dry Bulb, deg. F	78.5	83.3	84.6
Wet Bulb, deg. F	67.6	68.2	64.5
Dew Point, deg. F	62.2	60.5	52.3
Relative Humidity, per cent	56.5	45.0	32.0
Specific Humidity, grains per pound dry air	83.4	78.4	58.1
11. Mixed Air, leaving dehumidifier and entering dry air cooler			
Dry Bulb, deg. F	120.0	129.4	122.8
Wet Bulb, deg. F	72.0	73.0	69.3
Dew Point, deg. F	43.0	36.2	27.8
Relative Humidity, per cent	7.2	4.1	3.5
Specific Humidity, grains per pound dry air	40.8	31.2	21.7
12. Mixed Air, leaving Dry Air Cooler and entering Resaturation Cooler			
Dry Bulb, deg. F	78.0	77.6	78.1
Wet Bulb, deg. F	59.2	56.8	54.1
Dew Point, deg. F	45.4	39.3	30.0
Relative Humidity, per cent	30.8	24.8	16.5
Specific Humidity, grains per pound dry air	44.6	35.4	24.0
13. Mixed Air, leaving Resaturation Cooler			
Dry Bulb, deg. F	77.5	63.6	77.4
Wet Bulb, deg. F	59.4	57.8	54.8
Dew Point, deg. F	46.4	54.1	33.3
Relative Humidity, per cent	32.8	70.5	19.5
Specific Humidity, grains per pound dry air	46.6	62.0	27.8
14. Air Temperature drop through Cooling Unit, deg. F	1.0	19.7	7.2
15. Temperature cooled air leaving registers, average deg. F	78.3	71.4	79.5
16. Air Temperature rise in ducts and casing, deg. F	0.8	7.8	2.1
17. Basement Air Temperature at breathing level, deg. F	78.0	79.3	81.1
18. Quantity of Air through Cooling Unit			
Cubic feet per minute	804	804	804
Pounds per hour	3622	3622	3622
Density of air, lb. per cu. ft.	0.075	0.075	0.075
19. Number of house air recirculations per hr.	3.4	3.4	3.4
20. Ventilating air			
Cubic feet per minute	232	232	232
Pounds per hour	1041	1041	1041
Density of air, lb. per cu. ft.	0.075	0.075	0.075
21. Moisture removed from air, pounds per hr.	19.11	8.51	15.67
22. Heat given up by air; total B.t.u. per hour	21,810	26,770	23,510
Heat in moisture removed from air, B.t.u. per hour	20,920	9,340	17,200
Heat given up by moisture remaining in air, B.t.u. per hr	20	330	40
Heat due to moisture in air, total B.t.u. per hr.	20,940	9,670	17,240
Per cent of total	96.0	36.1	73.3
Sensible heat			
B.t.u. per hr.	870	17,100	6,270
Percent of total	4.0	63.9	26.7
23. Fan Speed, r.p.m.	510	510	510
24. Fan Motor Data			
Size, h.p.	0.75	0.75	0.75
Measured power rate, Kw	0.64	0.60	0.56
25. Cooling Unit Data			
Measured power rate, Kw	0.71	0.69	0.64
Measured Gas rate, cu. ft. per hour	103.6	95.1	93.4
Heating Value of Gas, B.t.u. per cu. ft.	1000	1000	1000
26. Activation Air entering house			
Dry Bulb, deg. F	76.0	98.1	97.3
Wet Bulb, deg. F	72.3	76.1	75.8
Dew Point, deg. F	71.0	67.5	67.3
Relative Humidity, per cent	84.0	37.0	38.0
Specific Humidity, grains per pound dry air	114.0	100.5	100.0
27. Activation Air leaving house			
Dry Bulb, deg. F	147.0	160.0	159.7
Wet Bulb, deg. F	99.0	99.2	96.6
Dew Point, deg. F	89.0	85.8	81.4
Relative Humidity, per cent	19.5	13.0	11.3
Specific Humidity, grains per pound dry air	210.0	189.0	164.0
28. Water Temperature in dry air cooler			
Inlet, deg. F	75.0	74.9	75.0
Outlet, deg. F	89.0	90.2	88.8
Rise, deg. F	14.0	15.3	13.8
29. Quantity of cooling water			
Pounds per hour	2465	2540	2545
Gallons per hour	296	305	305
30. Heat absorbed by cooling water, B.t.u. per hour	34,510	38,860	35,120

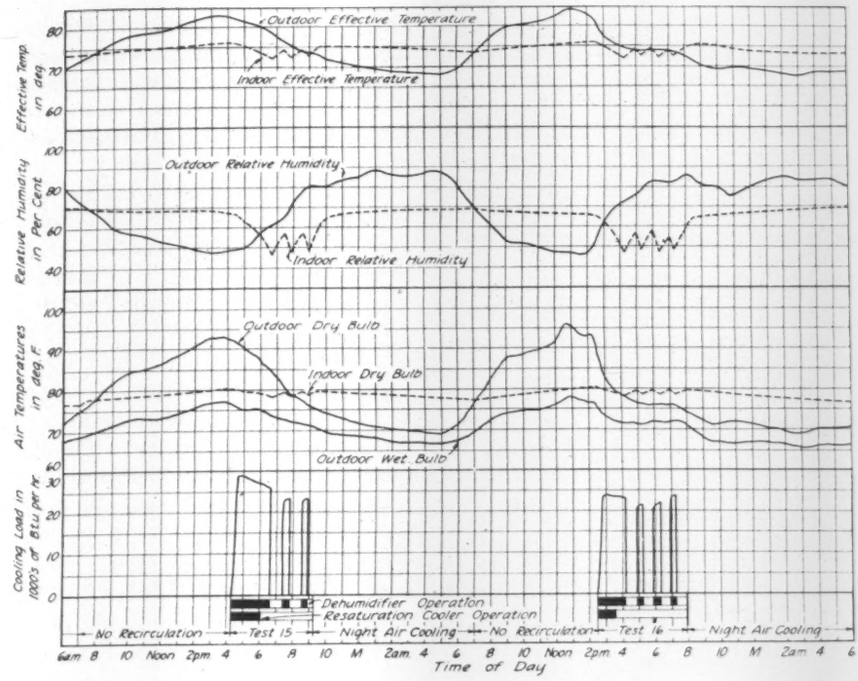
Outdoor Effective Temperature
Indoor Effective Temperature
Effective Temp. in deg
Outdoor Relative Humidity
Indoor Relative Humidity
Relative Humidity in Per Cent
Outdoor Dry Bulb
Indoor Dry Bulb
Outdoor Wet Bulb
Air Temperatures in deg F
Cooling Load in 1000's of Btu per hr
Dehumidifier Operation
Resaturation Cooler Operation
No Recirculation
Test 15
Night Air Cooling
No Recirculation
Test 16
Night Air Cooling
6am 8 10 Noon 2pm 4 6 8 10 M 2am 4 6 8 10 Noon 2pm 4 6 8 10 M 2am 4 6
Time of Day

Fig. 6—Graphic log of air temperatures, relative humidities, and cooling load—Tests 15 and 16, Series 3-40, Aug. 13 and 14, 1940

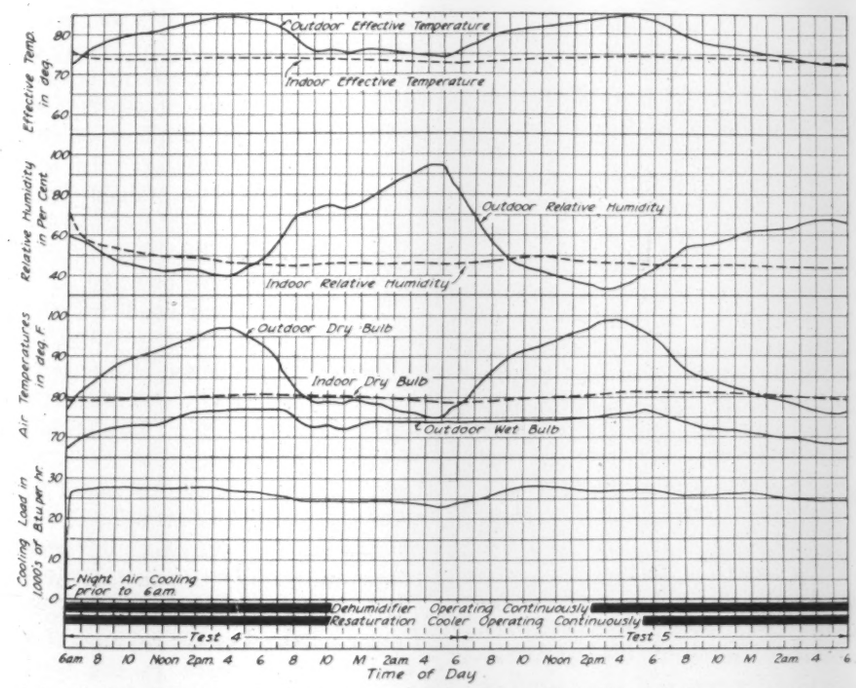
Outdoor Effective Temperature
Indoor Effective Temperature
Effective Temp. in deg
Outdoor Relative Humidity
Indoor Relative Humidity
Relative Humidity in Per Cent
Outdoor Dry Bulb
Indoor Dry Bulb
Outdoor Wet Bulb
Air Temperatures in deg F
Cooling Load in 1000's of Btu per hr
Night Air Cooling prior to 6am
Dehumidifier Operating Continuously
Resaturation Cooler Operating Continuously
Test 4
Test 5
6am 8 10 Noon 2pm 4 6 8 10 M 2am 4 6 8 10 Noon 2pm 4 6 8 10 M 2am 4 6
Time of Day

Fig. 7—Graphic log of air temperatures, relative humidities and cooling load—Tests 4 and 5, Series 2-40, July 24 and 25, 1940

day. On such nights, when the effective temperature outdoors is less than that indoors, most homeowners would be strongly impelled to open the windows, and any consideration of an ideal, convenient method of cooling the house will have to take into account the fundamental aversion to being confined indoors when the outdoor conditions are at least equally satisfactory. It is true that by the admission of very large quantities of ventilating air the desire to open the windows might be minimized. However, such quantities would have to be much greater than the one air change per hour required to minimize odors.

Low Relative Humidity. (Series 5-40.) As shown in Fig. 8, from 6 a.m. on July 29, 1940, to 6:42 p.m. on July 30, 1940, the plant was operated with the controls set to maintain approximately 83 F and 30 per cent relative humidity. At 6:00 a.m. on July 29, cooling with outdoor air at night was ended and cooling by means of the dehydration unit was begun.

The data shown in the third column of Table 3 were obtained after the dehumidifier and dry air cooler had been operating continuously for 8 hours. From Item 22 it may be observed that of the total amount of heat removed from the air, 26.7 per cent represented the heat absorbed in reducing the dry-bulb temperature and 73.3 per cent represented the heat absorbed in removing the water vapor.

It required practically nine hours of continuous operation of the dehumidifier and dry air cooler in order to reduce the relative humidity from 71.8 per cent at 6 a.m. to 25.5 per cent at 2:55 p.m., or a total reduction of 46 per cent. The reduction in humidity was extremely rapid during the first two hours of plant operation and much slower thereafter. After a period of cooling with outdoor air at night, the moisture which was removed consisted not only of that removed from the ventilating air and that due to occupants, but also of the moisture abstracted from the plaster, woodwork, and furnishings of the Residence.

Without considering the merits or demerits from the standpoint of comfort of operating with a low humidity and a comparatively high dry-bulb temperature, it is evident that if, for any reason, this method of operation is to be used, it cannot be used to any advantage in connection with supplementary cooling with outdoor air at night.

Cooling Loads and Effectiveness of Insulation. The calculated cooling loads, consisting of the sensible heat, moisture, and total heat loads, for the insulated and uninsulated structure are presented in Table 4. The application of insulation to the sidewalls and ceiling probably would not change the amount of water vapor brought in by the ventilation air or that given off by the occupants. Hence, the moisture load as shown in the second column of the table remained constant for the two cases. Any saving effected by the application of insulation, however, would be reflected in a reduction in the

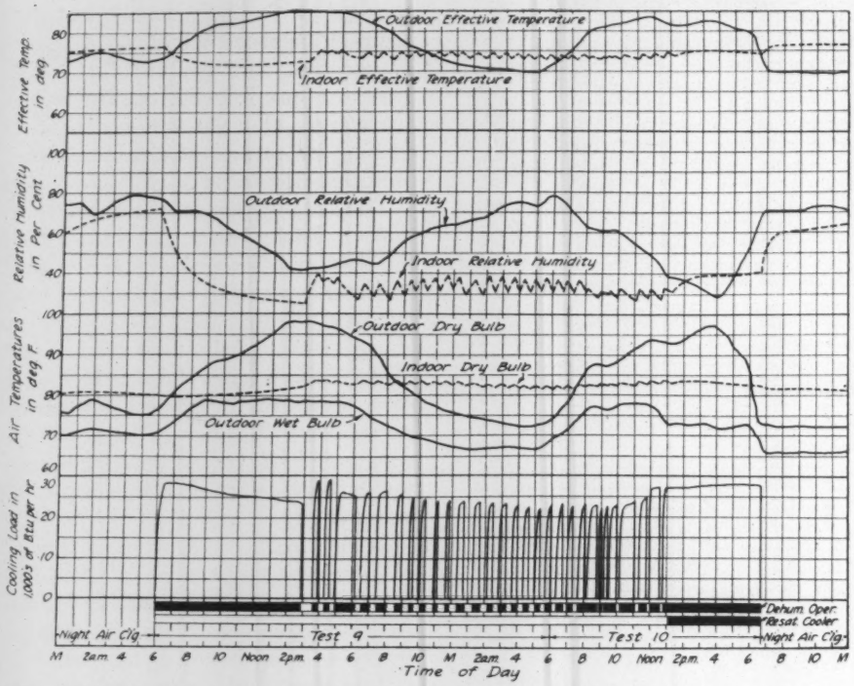
Outdoor Effective Temperature
Indoor Effective Temperature
Effective Temp. in deg
Outdoor Relative Humidity
Indoor Relative Humidity
Relative Humidity in Per Cent
Outdoor Dry Bulb
Indoor Dry Bulb
Outdoor Wet Bulb
Air Temperatures in deg F
Cooling Load in 1000's of Btu per hr
Dehum. Oper.
Resat. Cooler
Night Air Clg.
Test 9
Test 10
Night Air Clg.
M 2am 4 6 8 10 Noon 2pm 4 6 8 10 M 2am 4 6 8 10 Noon 2pm 4 6 8 10 M
Time of Day

Fig. 8—Graphic log of air temperatures, relative humidities, and cooling load—Tests 9 and 10, Series 5-40, July 29 and 30, 1940

sensible heat load. As shown by the first column in Table 4, the calculated sensible heat load was reduced from 32,260 Btu per hour to 20,060 Btu per hour representing a saving of 12,200 Btu per hour, or 37.8 per cent. The assumption is usually made that the reduction in the calculated hourly cooling load is indicative of the reductions to be expected in the total cooling load and operating costs for a given day or for a given season.

The sensible heat load obtained by test, expressed as the British thermal units absorbed per day in reducing the dry-bulb temperature of the air, is shown in Fig. 9 plotted against the degree-hours above 85 F per day. *Curve A* represents the results obtained in the insulated structure from the tests, designated as *Series 3-40*, which were started when the dry-bulb temperature on the second story rose to 81 F. *Curve B*, which has been reproduced from Engineering Experiment Station Bulletin 290, shows results from similar tests (*Series 3-34*) made in the uninsulated structure. A comparison of the *Curves A* and *B* shows that over a wide range of weather conditions, the average reduction in sensible heat load due to the insulation was approximately 33 per cent. This value is probably conservative due to the fact that more heat was lost to the basement from the dehydration unit than from the condensing unit used in 1934, and the basement temperature was accordingly about 2 F higher during the 1940 tests. It also agrees reasonably well with the calculated reduction in sensible heat load of 37.8 per cent given in the first column in Table 4. Corresponding percentage reductions in the total cooling load, which includes both moisture and sensible loads, would be smaller than the reduction in sensible heat load alone, as illustrated by a comparison of the values in the first and third columns in Table 4. The operating costs of the plant would be dependent upon the total cooling load, and not upon the sensible heat load alone. The moisture load is extremely variable but on the assumption that it was approximately the same for the seasons of 1934 and 1940 the reduction in total load effected by the insulation was of the order of 25 per cent.

Table 4—Calculated Cooling Load for Insulated and Uninsulated Residence

	Calculated Cooling Load Btu per Hour		
	Sensible	Latent	Total
Uninsulated.....	32,260	5,240	37,500
Insulated.....	20,060	5,240	25,300
Reduction.....	12,200	0	12,200
Reduction in per cent	37.8%	0	32.6%

Note: The calculated cooling load was based on accepted method given in ASHVE Guide. Conditions assumed were:

Outdoor dry bulb	= 95 F
Wet bulb	= 76 F
Indoor dry bulb	= 80 F
Relative humidity	= 50 per cent
Ventilation air	= one change per hour

It may be observed from the first column in Table 4 that the moisture load, as calculated in standard practice from that brought in by infiltration, or the ventilating air, and that given off by occupants was 5240 Btu per hour. The actual hourly moisture loads, obtained after periods of at least six hours of continuous operation, on three days on which the outdoor dry-bulb temperature was approximately 95 F and the wet-bulb approximately 76 F, corresponding to design conditions, were 9640, 9860, 9860, 10610, 10750, 11440 and 11620 Btu per hour. This large discrepancy probably results from the fact that water vapor is not merely brought into a structure as an accompaniment of air leaking in, but permeates all materials and enters all openings in amounts that are dependent on the difference in vapor pressure, and which may be independent of the amount of air inleakage. In the light of this fact it is probable that some revision of the commonly accepted practice in the calculation of moisture loads should be made.

The sensible heat load for the tests made with constant effective temperature maintained in the Residence (*Series 2-40*) is designated as *Curve C* in Fig. 9. It may be observed by comparing *Curve C* with *Curve A* that the improvement in comfort conditions, resulting from maintaining a constant effective temperature of 74 deg instead of a constant dry-bulb temperature of 80 F, was obtained at the expense of a considerable increase in the total time of plant operation and hence in operating cost. It is probable that for extremely hot days, represented

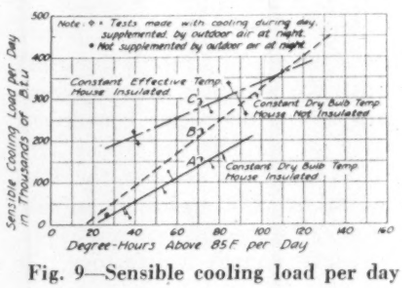
Note: ⊕ = Tests made with cooling during day supplemented by outdoor air at night.
• Not supplemented by outdoor air at night.
Constant Effective Temp. House Insulated
Constant Dry Bulb Temp. House Not Insulated
Constant Dry Bulb Temp. House Insulated
C
B
A
Sensible Cooling Load per Day in Thousands of Btu
Degree-Hours Above 85 F per Day

Fig. 9—Sensible cooling load per day

by larger values of degree-hours, *Curves A* and *C* would tend to converge.

Summary and Conclusions

The following summary and conclusions may be considered as applying to the Research Residence and the conditions under which the tests were conducted.

1. The method of operation by which the cooling plant was started when the indoor effective temperature rose to 74 deg after a period of supplementary cooling with outdoor air at night, was more satisfactory than the one by which the cooling plant was started when the indoor dry-bulb temperature rose to 81 F, in that it eliminated the period of discomfort occurring just previous to the start of the cooling unit.

2. By the use of the dehydrating unit it was possible to maintain comparatively uniform relative humidity, and consequently uniform comfort conditions, irrespective as to whether the plant operated continuously or intermittently.

3. The use of insulation in the sidewalls and ceiling effected a saving of approximately 33 per cent in the sensible heat load and of the order of 25 per cent in the total heat load.

4. Lack of agreement between the calculated design moisture load and the actual moisture load indicates that moisture permeating the structure may be independent of the amount of infiltration or ventilation air, and suggests that some revision may be advisable in the commonly accepted method for calculating moisture load.

Acknowledgments

The results presented in this paper were obtained in connection with the summer cooling investigation (1940) in the Research Residence[7] at the University of Illinois, conducted by the Engineering Experiment Station of which M. L. Enger, dean of the College of Engineering, is the director, and in the Department of Mechanical Engineering of which O. A. Leutwiler, professor of Mechanical Engineering Design, is the head. These results will ultimately comprise part of a bulletin of the Engineering Experiment Station. Acknowledgment is due M. K. Fahnestock, Research Associate Professor, for his interest and assistance in this work, and to H. R. Stover, Research Graduate Assistant and J. C. Miles, Instructor, for services rendered in connection with the investigation. Acknowledgment is also due to the *American Gas Association* for active cooperation, and to the various manufacturers who furnished instruments and equipment.

[7] The Research Residence in Urbana, Illinois, was built, furnished and completely equipped specifically for research work in warm air heating by the *National Warm Air Heating and Air Conditioning Association* in December, 1924.

Engineers in Defense Program

According to an American Engineering Council Bulletin, engineers who wish to offer their services to the Federal Government in the defense program have three main avenues of approach, (1) direct employment, (2) engagement on a consulting basis, and (3) as an employee or consultant of a contractor having a government contract. A brief outline of how employment in these three categories may be accomplished is given below:

Direct employment: With relatively few exceptions, employment in government departments, bureaus, independent agencies and the like is under civil service rules and regulations. Competitive examinations produce eligible lists, from which names are certified to those government agencies making requests. Personnel is being added to several agencies directly concerned with the defense program such as War, Navy, and the Defense Commission, but most appointments are being made from Civil Service eligible lists already in existence. And many jobs are being handled by calling reserve officers of the Army and Navy to active duty. Thus the chance of obtaining immediate direct employment is somewhat remote for those not having civil service status or not being in the organized reserves.

Consulting basis: The engagement of engineers on a consulting basis is handled by each government agency in accordance with rules and regulations of long standing, although in a few cases recent simplifications to expedite procedure have been made. In general, compensation is on a per diem basis and only in exceptional cases does the rate exceed $25 per day. Applications for consulting work in the Army are being handled by the Construction Advisory Board, 1125 Munitions Building, Washington, D. C. and for the Navy by Bureau of Yards and Docks, Navy Department, Washington, D. C.

Contractors' staffs: Contractors on defense work will of course engage their own employees and consultants. The policy adopted by the government is to award contracts, whether for the consulting services of engineers or for construction, to those qualified to handle the work who reside in the region where it is to be done. In a few cases, the construction contract also includes the design, but this is exceptional. However, engineering firms who are also contractors might well make their qualifications known to the Construction Advisory Board.

It should be understood that the National Defense Advisory Commission itself awards no contracts, but merely serves as a coordinator to assist the regular Federal agencies in carrying out their individual programs.

ASA Annual Meeting

The *American Standards Association* will hold its Annual Meeting December 11 at the Hotel Astor, New York, according to the announcement of Pres. Edmund A. Prentis. A meeting of the Standards' Council is scheduled during the morning and will be followed by a meeting of the Board of Directors. At the luncheon meeting, there will be a brief report of the year's activities and Representative Hatton W. Sumners, Chairman of the House Judiciary Committee, will talk on the importance of standardization on the cooperative relations of government and industry.

Officers for 1941 will be announced at the conclusion of the luncheon meeting.

Reheating by Means of Refrigerant Compressor Discharge Gas

By S. F. Nicoll* (*MEMBER*), York, Pa.

SUMMARY

The principles involving the use of compressor discharge gas reheat and a general discussion of reheat are of interest to all engaged in the field of air conditioning.

The provision of suitable means for regulating the capacity of air conditioning equipment and means of altering the relative proportion of sensible and latent heat removal are important. Typical examples of a number of ways of accomplishing this are illustrated. Compressor discharge gas reheat may be used to neutralize the sensible cooling effect when dehumidification alone is required and may be used to completely or partially offset sensible cooling. Practical methods are described.

SUMMER air conditioning usually requires the simultaneous removal of sensible and latent heat from the treated air. The sensible cooling and moisture removal are sometimes accomplished independently, but more often a spray dehumidifier or a refrigerated coil performs both functions at once. This paper deals with this combined sensible and latent cooling and with the means for varying the relative proportions of each, particularly with regard to the usefulness of compressor discharge gas for this purpose. The discussion will be limited to coils as the cooling means, although the principles set forth apply also to spray dehumidifiers.

It is believed that the principles surrounding the use of condenser discharge gas reheat and the discussion of reheat generally as set forth in this paper will be of interest to the air conditioning industry.

Basic Principles

It is not within the scope of this paper to discuss methods of rating coils. A review of some of the fundamentals, however, provides an understanding of the phenomenon of simultaneous sensible and latent cooling. If a straight line is drawn on a non-logarithmic psychrometric chart through points representing the conditions of the air entering and air leaving the cooling coil, its slope will be a measure of the so-called *load-ratio* and the line can be referred to as the *load ratio line*. The load ratio may be expressed in various ways but, for the purposes of this paper, will be considered as the ratio of total to sensible heat removal. If the load ratio line is extended to intersect the saturation curve, there will result a relationship known as the *straight line law*. This law states that the point of intersection with the saturation curve can be considered the *coil surface temperature*. A straight line drawn through points representing the entering air condition and the coil surface temperature will then be the load ratio line and the leaving air condition must fall also on this line. A reference to Fig. 1 will show that, for a given entering air condition, the load ratio and therefore the proportion of latent cooling, will increase as the coil surface temperature decreases. Although somewhat of an approximation, it is generally assumed that the load ratio can be increased by decreasing the coil surface temperature only until the load ratio line becomes tangent to the saturation curve as, for instance, line *A-B* in Fig. 1. If a greater load ratio is wanted, such as represented by line *A-C*, it will be necessary to have recourse to reheat to neutralize the unwanted sensible cooling which will accompany the desired dehumidification. For instance, air may be cooled so that the leaving temperature falls at point *D* on the 75 load ratio line and then reheated from 55 deg to 75 deg so as to leave at point *E* on the desired load ratio line *A-C*. Again, air may be treated so that its leaving temperature falls at point *F* on load ratio *A-B* and then reheated to point *G*. The quantity and the choice of conditioning equipment will determine whether path *A-D-E*, or *A-F-G*, or some other is chosen. If sufficient reheat is applied to neutralize all sensible cooling, there will be dehumidification only. The load ratio, as defined, is then infinite and the load ratio line will be *A-H*.

The selection of cooling equipment is based on chosen design maximum sensible and latent loads. Because of variations in weather conditions, internally generated heat, etc. the apparatus is seldom presented with a required load or load ratio equal to that upon which the original selection was based. Cases often arise necessitating a greater load ratio at a light load than at the maximum total load, because of a disappearance of part of the sensible load without a corresponding decrease in the latent cooling requirements. Unless some provision is made to accommodate the capacity

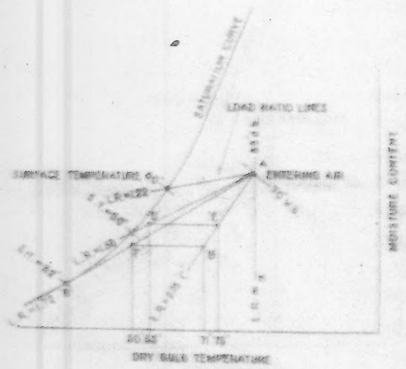

Fig. 1—Chart for determining load ratio

*Air Conditioning Application Engr., Vilter Manufacturing Corp.

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and load ratio of the cooling equipment to the requirements, the dry-bulb temperature will under these circumstances fall to the minimum permissible and the apparatus will be stopped by the controlling thermostat. This results in the undesirable condition of high humidity at light sensible loads so common with the conventional comfort conditioning system without bypass, reheat or other means for satisfactorily altering the load ratio with changes of load. Under these circumstances also, the cooling equipment operates intermittently and tends to cycle, on and off, at short intervals, which has a very adverse effect on the relative humidity. During the *off* periods untreated outside air, usually of relatively high moisture content, is admitted. Any moisture on the coils or undrained from the apparatus tends to re-evaporate into the air stream. A considerable portion of the operation may take place at a high coil surface temperature and therefore low load ratio, further aggravating the humidity condition. To improve the humidity situation some arrangement should be used to modify the equipment load ratio as required and to avoid short cycling operation. This is, of course, an absolute necessity on industrial installations where definite temperatures and humidities must be maintained.

Regulation

A number of arrangements are in common use to accommodate the apparatus performance to changes in load. The degree of effectiveness varies. Some alter the equipment load ratio accurately, while others are advantageous chiefly in keeping refrigeration on the coils, or part of them, at light loads and avoiding therefore the adverse effects of rapid *on* and *off* control. The most usual types of control are, unloading the compressor, coil face control, coil thickness control, starving the refrigerant feed (with volatile refrigerant), air volume control, the auditorium bypass, and reheat (either alone or in combination with certain of the others). Compressor unloading may be accomplished by change of speed, stopping individuals of a group or by capacity reducing devices. With face control the cooling coil is divided into several parts, parallel as to the air flow, one or more of which can be put in and out of operation by the control (see Fig. 2*A*). When the entering air is a mixture of recirculated and outside air, this arrangement admits some untreated outside air to the conditioned space when the controlled coil section is off. Coil thickness control consists in varying the number of rows deep in operation, as shown in Fig. 2*B*. This is equivalent to the starving of the refrigerant feed as shown in Fig. 2*C*, when the refrigerant feeds through the coil parallel to the direction of air flow, as is common. The auditorium bypass is shown in Fig. 2*D*. As far as the cooling equipment is concerned, both the bypass and volume control, Fig. 2*E*, act to reduce the air quantity through the cooling coil and for purposes of this discussion are therefore considered equivalent. Reheat is commonly used in two arrangements, Figs. 2*F* and 2*G*. A modification of Fig. 2*F* consists in placing the reheat coil in the bypass instead of between cooling coil and fan as shown (see Fig. 4). Other means of control are sometimes used but the foregoing will serve the purposes of this discussion.

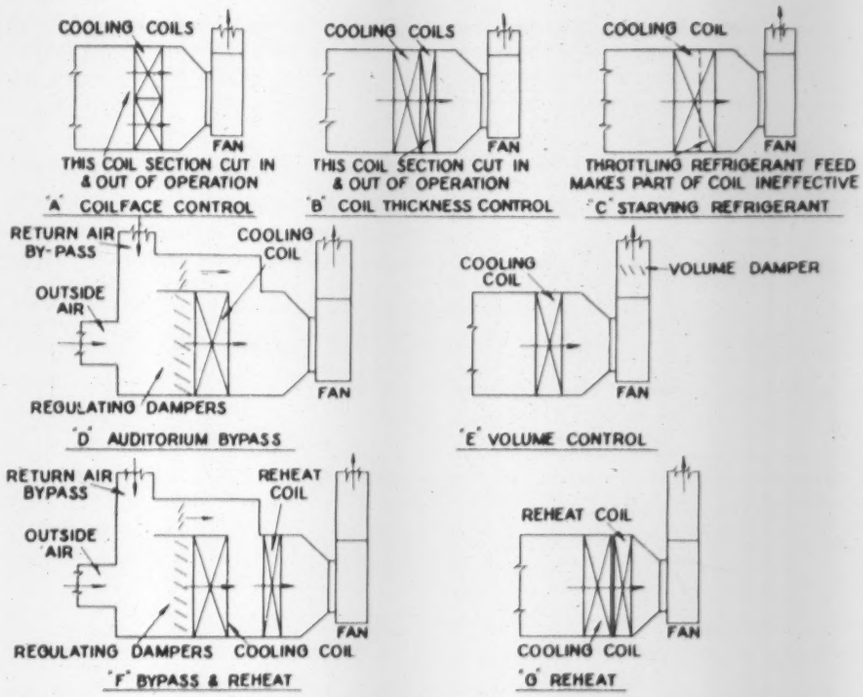

Fig. 2—Typical arrangement for regulation total capacity in load ratio

The comparative performance of the arrangements shown in Fig. 2, and especially the part that can be played by reheat, is best illustrated by a specific example. Consider a comfort cooling installation for which the cooling equipment selection is made for the maximum load given in Table 1. Suppose that it is desired to hold inside conditions of 74 deg and 50 per cent when the minimum load indicated in Table 1 prevails. The values in Table 1 are based on arbitrary assumptions of outside air quantity and condition as well as population and internally generated heat, but are sufficiently typical for illustrative purposes.

A 10 hp "Freon-12" water cooled condensing unit and a six row cooling coil, of typical design, handling 4500 cfm, will satisfy the maximum load requirements given in Table 1. Table 2 shows how the equipment as originally selected and variously modified will perform under the minimum load conditions.

Table 2 shows that all of the arrangements listed will satisfy the sensible load, but their effectiveness in removing the necessary moisture varies widely. Those with a load ratio less than the required 1.97 will not succeed in producing the required relative humidity because the running time will be fixed by the thermostat to suit the sensible load and the latent heat abstraction will be insufficient. *Cases* 1 to 5 cannot therefore attain the

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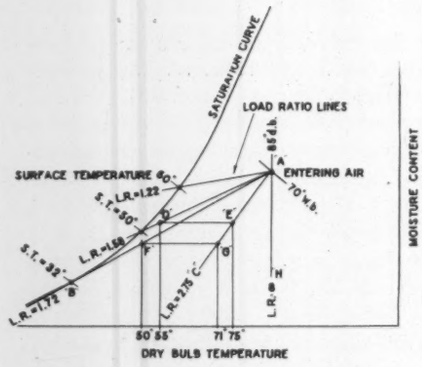

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*Air Conditioning Application Engr., York Ice Machinery Corp.

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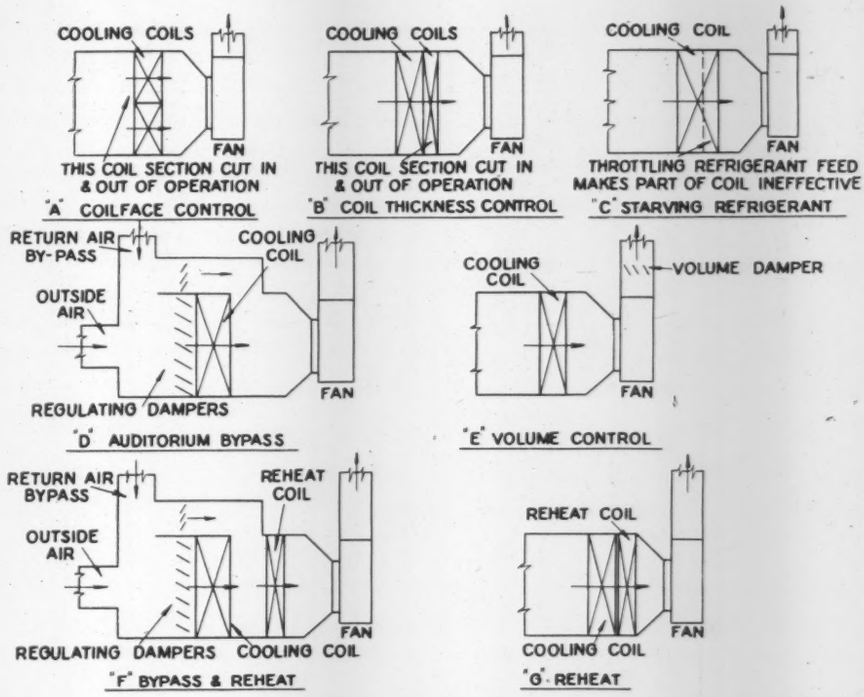

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The comparative performance of the arrangements shown in Fig. 2, and especially the part that can be played by reheat, is best illustrated by a specific example. Consider a comfort cooling installation for which the cooling equipment selection is made for the maximum load given in Table 1. Suppose that it is desired to hold inside conditions of 74 deg and 50 per cent when the minimum load indicated in Table 1 prevails. The values in Table 1 are based on arbitrary assumptions of outside air quantity and condition as well as population and internally generated heat, but are sufficiently typical for illustrative purposes.

A 10 hp "Freon-12" water cooled condensing unit and a six row cooling coil, of typical design, handling 4500 cfm, will satisfy the maximum load requirements given in Table 1. Table 2 shows how the equipment as originally selected and variously modified will perform under the minimum load conditions.

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Table 1—Typical Requirements for Comfort Cooling Installation

	Maximum Load	Minimum Load
Air Entering Coils	83.5 deg dry-bulb and 69.1 deg wet-bulb	74.2 deg dry-bulb and 64 deg wet-bulb
Inside Conditions	80 deg dry-bulb and 50 per cent relative humidity	74 deg dry-bulb and 50 per cent relative humidity
Total Sensible Load	94800 Btu per hour	40300 Btu per hour
Total Latent Load	36000 Btu per hour	39200 Btu per hour
Total Load	130800 Btu per hour	79500 Btu per hour
Load Ratio	1.38	1.97

Table 2—Reheating Equipment Performance at Light Load Condition

	Required	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
Total load Btu per hour	79500	118300	73200	77900	106300	100800	79600	79100	81400
Sensible load Btu per hour	40300	79100	61000	51900	67300	60700	40400	40100	41300
Latent load Btu per hour	39200	39200	12200	26000	39000	40100	39200	39000	40100
Load ratio	1.97	1.50	1.20	1.50	1.57	1.66	1.97	1.97	1.97
Reheat Btu per hour	.....	None	None	None	None	None	38700	27200	19400
					Total Compressor Load		118300	106300	100800

Notes:—*Case* 1—Original equipment without change rebalanced against minimum load conditions.
Case 2—Compressor speed reduced to half.
Case 3—Coil face reduced to half, Fig. 2*A*.
Case 4—Coil reduced from 6 to 4 rows deep, Fig. 2*B*. This is equivalent also to starving the coil of refrigerant, Fig. 2*C*.
Case 5—Auditorium bypass handling 2400 cfm recirculated air, Fig. 2*D*. This is equivalent also to volume control.
Case 6—*Case* 1 with reheat as indicated.
Case 7—*Case* 4 with reheat as indicated.
Case 8—*Case* 5 with reheat as indicated.

desired conditions. A line on the psychrometric chart tangent to the saturation curve and through the minimum load entering air conditions will have a slope equivalent to a load ratio of 1.70. As described previously, then, it will be considered impossible with air entering at 74.2 deg dry-bulb and 64 deg wet-bulb, to attain a load ratio in excess of 1.70 without reheat. It is of interest to observe how closely this limit can be approached by the various non-reheat arrangements shown in Fig. 2. In *Case* 2, the rebalance between the original coil and the reduced compressor displacement will result in so high a coil temperature as to greatly reduce the proportional dehumidification. *Cases* 3 and 4 are much better in this respect, whereas the auditorium bypass, *Case* 5, is still more effective. Quite aside from the performance shown in Table 2, *Cases* 2 to 5 have the advantage over *Case* 1 of longer running time before the low limit of temperature is attained and therefore, minimize the disadvantages of *on* and *off* operation described previously. This situation is not susceptible of even reasonable mathematical treatment and no modification for it appears in Table 2. Although frequently used on comfort installations no non-reheat case would be effective on an industrial installation, where a definite temperature and humidity must be maintained.

It is true, of course, that Table 2 would change somewhat if the requirements, equipment selection, and modifications were varied. It is believed, however, that the situation as presented is sufficiently representative of practical conditions to justify the conclusions. At any rate, without the use of reheat it is impossible to attain the required load ratio of 1.97.

A further reference to Table 2 will show that in *Cases* 1, 4, and 5, there is sufficient sensible and latent capacity but there is a proportional excess of the former. If reheat be applied to the air stream leaving the cooling coil, there will result *Cases* 6, 7 and 8, in which the required conditions will be attained. Table 2 shows also that *Case* 7, and to a still greater extent, the auditorium bypass in *Case* 8, are effective in reducing the refrigeration and reheat requirements as compared to *Case* 6.

Sources of Reheat

The reheating may be accomplished by various means. Office buildings, stores, and hotels frequently have steam available in summer and in the spring and fall seasons, which they must waste at low pressure and which is conveniently available for reheating purposes. There are even comfort cooling installations where, to keep the humidity down, the winter heating system has been placed in operation as a means of reheat. Steam, hot water, electricity or refrigerant compressor discharge gas may be used for reheating.

When a compressor and coil are operating to cool and dehumidify air the heat extracted from the air, together with the heat equivalent of the horsepower expended upon the refrigerant, must be rejected in the condenser. Moreover, the cooling effect is the sum of sensible and latent heat abstraction. If the compressor discharge gas is used for reheating purposes there will be available, in all cases, much more than enough rejected heat to counteract the entire sensible cooling effect of the equipment. Although there is rejected heat available to raise the dry-bulb temperature of the air above that at which it enters the conditioning equipment, it has not been common, in installations so far made, to do more than to simply neutralize the whole sensible cooling effect. It is to be noted that, since the source of reheat is the refrigerating system itself, there will be no heat available for reheating unless the cooling equipment is already running for dehumidifying purposes.

By the use of compressor discharge gas there is automatically made available a source of reheat without incurring the expense of steam, hot water, or electricity for that purpose. On the majority of air conditioning installations, steam or hot water are either not available at all during the cooling and dehumidifying season, or can be produced only by operation of the winter heating plant specifically for reheating purposes, often an inconvenient and expensive situation.

Compressor discharge gas has another advantage as against other sources of reheat. Because of the effectiveness of the reheat coil as a refrigerant condenser, the condensing water requirements are cut down, thus reducing operating expense.

Compressor Discharge Gas Reheat

Fig. 3 illustrates a typical arrangement for compressor discharge gas reheat. The reheater is simply a condenser coil located in the air

leaving the cooling apparatus. This condensing, or reheat coil, is arranged in parallel with the main condenser, which may be water or air cooled or of the evaporative type.

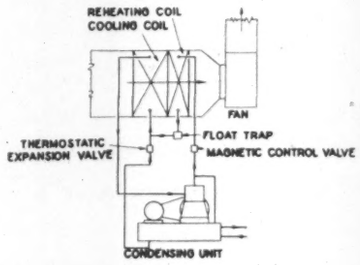


Fig. 3—Arrangement for compressor discharge gas reheat

The reheat coil requires some form of control such as the valve shown, as well as a means for disposing of the condensed liquid; that is, some equivalent of the steam trap that would be used with a steam coil. It is apparent that reheat will generally be used at times when the total refrigerating load is less than the maximum. Besides, the reheat coil acts as additional condensing capacity over that provided in the condensing unit. A fall in condensing pressure, and corresponding temperature will result when the reheat coil is in operation unless some provision is made to prevent it. This fall of condensing temperature will reduce the reheat capacity and may also result in too low a differential pressure between high and low sides of the refrigerating system to handle the required liquid through piping, thermal expansion valves, etc., and against any static head that may exist. It is frequently necessary, therefore, to provide some means for maintaining the condensing pressure at some design value. This value may be lower than that expected at peak load conditions. On a water cooled condenser, a pressure actuated water valve will serve this purpose. On evaporative condensers the water circulating pump may be operated intermittently, the air supply throttled, or both, by a control device sensitive to the condenser pressure.

The cooling coil and reheat coils bear certain relationships to each other. The liquid condensed in any reheat coil should be fed to the cooling coil in the same air circuit. If, for instance, there were several cooling systems with reheat coils on a common compressor and the principles previously described were not observed some reheat coil might feed more liquid into some cooling coil than it could evaporate, a condition which could not be tolerated. If properly arranged, on the other hand, the reheat coil will condense a liquid quantity only sufficient to neutralize the sensible cooling of the air and, since the cooling coil removes both sensible and latent heat from the same air, there will always be less liquid furnished to the cooling coil by the reheat coil than the total cooling load requires. The thermostatic expansion valve, as shown in Fig. 3, will then control

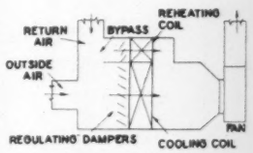


Fig. 4—Arrangement with reheat coil in bypass

the liquid feed so as to maintain the required suction superheat.

Several arrangements of the air treating apparatus have been used. The reheat coil may be in the air leaving the cooling coil, as shown in Fig. 3, or in the bypass (see Fig. 4). Several reheat coils may serve individual zones as in Fig. 5. It is

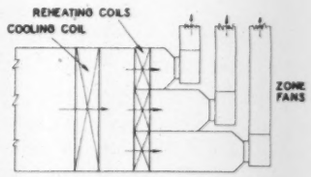


Fig. 5—Reheat coil arrangement for individual zones

possible also to place the reheat coil as indicated in Fig. *2F*. A reheat coil when used in combination with a bypass, as in Fig. *2F*, and particularly as in Fig. 4, will be exposed to an appreciably higher air temperature than the reheater in Fig. 3. This is compensated for to some degree by the comparatively greater reheat that the Fig. 3 arrangement will require for a given effectiveness in changing the load ratio. Compare, for instance, *Case* 6 with *Case* 8, in Table 2.

Reference to Table 2 will show that the total compressor load, and therefore the operating expense is less with *Case* 7 than with *Case* 6 and still less with *Case* 8. The bypass, *Case* 8, is therefore an effective means for reducing operating cost on reheat installations of this type. It does, however, present added first cost and complication and is not conveniently arranged in many air conditioning units. For these reasons an analysis of the requirements has resulted in the choice of the arrangement illustrated by *Case* 6 and Fig. 3 in most instances.

The most usual refrigerant hookup is shown in Fig. 3. If, however, the reheat coil is a considerable distance above the high pressure liquid receiver it is possible to use the arrangement shown in Fig. 6. The condensed liquid is returned to the high pressure receiver by gravity instead of to the cooling coil by pressure difference. The return pipe enters the receiver below the liquid level and the liquid stands in this pipe to a height corresponding to the pressure drop through the reheat coil and the connections to and from it.

Usually a reheat coil is selected with a capacity sufficient to counteract all sensible cooling, so that the equipment can serve to dehumidify only when required; thus it can be termed *complete reheating*. On the other hand, for comfort cooling applications particularly, there have been instances of less than complete reheating because of apparatus or space restrictions or other reasons. This may be termed *partial reheat*, and serves to increase the apparatus load ratio beyond the limit described as line "*A-B*" in Fig. 1, but not up to the point of dehumidification alone without sensible cooling. A reheat coil of this type in an audi-

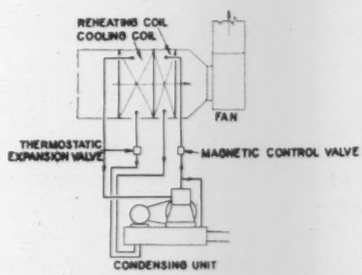


Fig. 6—The equipment arrangement when distant reheat coil is used

torium bypass simply increases the effectiveness of the bypass as a load ratio corrector.

Automatic control may be accomplished in various ways. If a reheat coil is located in an air bypass, the capacity is varied by the action of the bypass damper. In this case the control is gradual. When, however, reheat is controlled by a magnetic valve as in Fig. 3 the regulation is of the *on* and *off* type. Both methods of control have been used successfully.

It will be apparent that there is an inherent difference between the regulation of *partial* and of *complete* reheat. With partial reheat a fall in dry-bulb temperature in the conditioned space below a permissible limit would be possible where the equipment operated for dehumidification at times of light sensible load. Some form of low temperature limit is therefore necessary. This low limit can stop the cooling before the dehumidification has reached a point that will satisfy the humidity control. On the other hand, this circumstance is impossible with complete reheat and no low limit device is used.

Typical Installations

The application of refrigerant compressor gas reheat is illustrated by several typical installations which are described in detail. Fig. 7 depicts a comfort installation for summer cooling only incorporating complete reheat, and also shows there is no air bypass and the reheating coil is located beyond the cooling coil. There are two thermostats and a humidistat. The compressor may be operated by either humidistat *A* or thermostat *B*, these instruments being in parallel. A second thermostat *C*, set somewhat lower than *A* operates the magnetic valve *D*. If the dry-bulb temperature falls because the compressor is operating for dehumidification thermostat *C* will open valve *D*, thereby furnishing reheat. The compressor will continue to run and the reheat will cycle *on* and *off* until the humidistat is satisfied. The condenser is water cooled and the water regulating valve reduces the water flow so as to maintain the condenser pressure when the reheat is on.

There is shown in Fig. 8 a year 'round installation in which the reheat coil is divided into two steps so that the effect will approach gradual control more nearly than if a single reheat coil were used. With both reheat coils in operation the sensible cooling is entirely counteracted so that this is another example of complete reheating. As shown in Fig. 8 the reheating coils are located in the air stream downstream from the cooling coil and are followed by the humidifying spray and steam heating coil. It is worthy of note that, in this case, fixed orifices are used in place of a float drainer in the liquid outlets from the reheating coils.

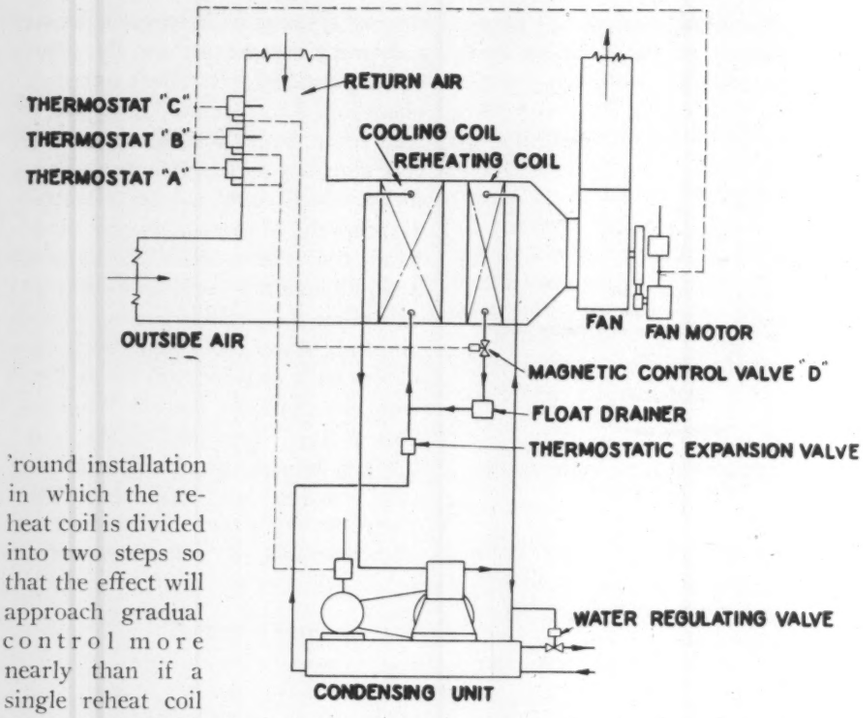


Fig. 7—Layout of summer cooling installation with refrigerant compressor gas reheat

For summer control there is a two step thermostat *A* and a humidistat *B* in the return air. The thermostat makes two contacts in succession with fall of return air temperature. As long as the temperature is so high that neither contact is made the compressor will run for sensible cooling. Should the temperature fall until the first contact is closed a normally closed relay *C* in the compressor starting circuit is opened as is also the magnetic valve *D* controlling the first section of the reheat coil. If the humidistat *B*, which is in parallel with this relay, does not require further cooling for dehumidification the compressor will stop. Should latent cooling be necessary the humidistat will keep the compressor running with the first section of reheat coil on. A further fall in dry-bulb temperature will cause the thermostat to close its second circuit and open the controlling magnetic valve *E* on the second reheat coil. Operation will then continue without further fall of dry-bulb temperature until the humidistat is satisfied and the compressor is stopped. The condenser is water cooled and the water regulating valve serves to maintain the condensing pressure when the reheat is on.

For winter operation there is a thermostat operating a control valve in the steam supply to the heating coil. A humidistat operates the humidifying spray.

Fig. 9 illustrates the use of partial reheat with the heating coil in the air bypass and with the reheating capacity regulated by the bypass damper. This is a year 'round installation. As will be seen from Fig. 9 this installation incorporates an evaporative condenser.

For summer control there is a thermostat *A* whose setting is adjusted by an outside instrument *B* so as to call for a variation of inside with outside temperature changes. Thermostat *A* operates a damper motor *C* which gradually closes the coil face damper and opens the bypass, with fall of temperature, and

vice versa. There is mounted on the damper motor shaft a cam which causes the magnetic control valve *D* to open somewhat after the bypass damper has left its closed position. This places the reheat coil in operation. The position of the bypass damper regulates the degree of reheat. The damper motor incorporates a second cam so arranged as to keep the compressor and evaporative condenser in operation at all times except when the bypass damper is wide open. It will be recognized that there is no definite summer humidity control in this installation. The reheat coil serves only to keep the compressor in operation longer, before the lowest permissible temperature is reached, than would be the case in a bypass installation without reheat. The effect of this is to produce lower relative humidities at light sensible loads than would be possible with the bypass alone. A pressure switch operates the circulating pump on the evaporative condenser intermittently to maintain the condenser pressure where the reheat coil is on.

For winter control a thermostat regulates the steam supply to the heating coil and humidistat operates the humidifying sprays.

Although there have been a good many variations in the arrangement of equipment and control the installations illustrated in Figs. 7, 8 and 9 will serve to show the principles involved in the application of compressor discharge gas reheat.

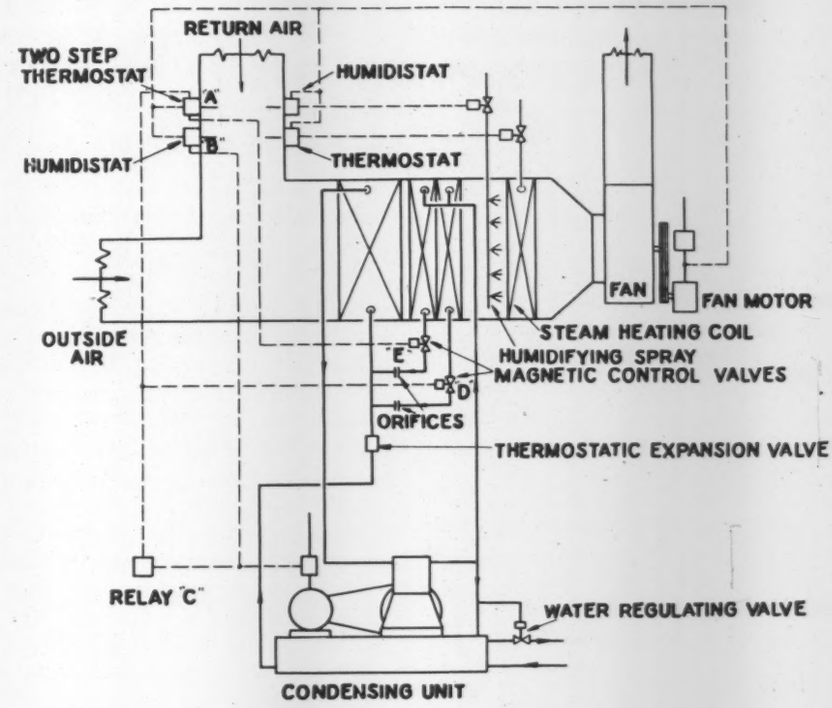


Fig. 8—Year 'round installation with divided reheat coil for graduate control

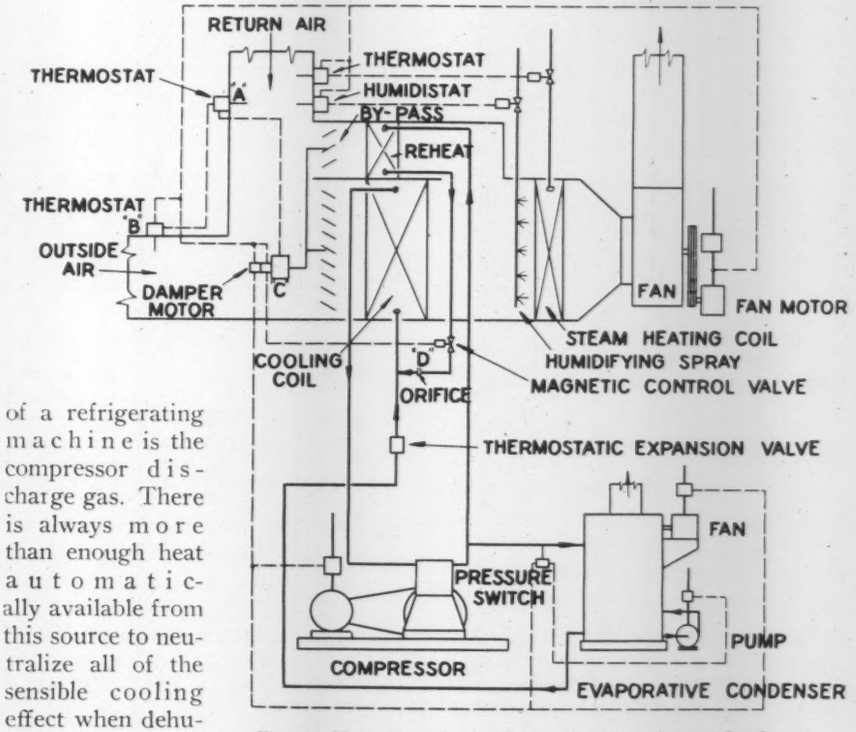


Fig. 9—Year 'round installation for use of partial reheat

Conclusions

The provision of suitable means for regulating the capacity of air conditioning equipment and particularly for altering the relative proportions of sensible and latent heat removal, is of great importance. There are a number of ways to accomplish this with spray or coil conditioning apparatus but all of them, with the exception of reheat, are quite limited in the degree to which they can obtain relatively high latent cooling at times of small sensible load. By proper use of reheat it is possible to dehumidify with any degree of sensible cooling from the maximum provided for in the equipment down to zero. A source of reheat inherent in the operating cycle of a refrigerating machine is the compressor discharge gas. There is always more than enough heat automatically available from this source to neutralize all of the sensible cooling effect when dehumidification alone is required. Depending on the requirements of individual cases, compressor discharge gas reheat may be used to the extent of completely or only partially offsetting sensible cooling. In the latter case dehumidification without sensible cooling will not be possible but the proportion of latent heat abstraction will be greater than attainable without the reheat.

A sufficient number of installations of various types and sizes have been in operation for several years to demonstrate the practicability and effectiveness of compressor discharge gas reheat.

Method of Determining Rectangular Equivalents and Weights of Ducts

By Peter Franck* (*MEMBER*), New York, N. Y.

INCREASING usage of air distributing systems in connection with air conditioning and ventilating systems in the past few years has resulted in a keen interest in developing improved engineering methods of designing and estimating duct work. Well established formulae and charts are available in the HEATING, VENTILATING, AIR CONDITIONING GUIDE, and in numerous engineering handbooks for estimating the carrying capacity of a given size of round pipe for a given velocity or pressure loss.

As square or rectangular ducts are more commonly used for carrying air it is necessary to convert from round pipe sizes obtained from a friction chart in many engineering problems. Or in some cases the rectangular duct size is known and it is desirable to know the equivalent diameter of round pipe to carry the same volume of air and at the same time have the same friction loss per foot of length.

Formulae and tables are available for determining the circular equivalents of rectangular ducts for equal friction and capacity. The graph represented in Fig. 1 was constructed to simplify the selection of rectangular duct sizes when the diameter of a round duct of equal friction is given.

In the solution of an air conditioning or ventilating problem the required diameter of the round duct is first determined on a friction chart by the volume of air and the permissible friction or velocity; and the final result is found on one of the slanting *diagonal* lines of the friction chart. This duct diameter may then be transfered to the *equal friction chart* of Fig. 1, and a curve is determined, also running roughly *diagonally* on the chart, corresponding to the diameter. The ordinate and abscissa of any point lying on this curve represent respectively the two sides of a rectangular duct with equal friction. Also from this curve all practical duct sizes may readily be determined, or, after one duct size has been established by design conditions, the other side may easily be found.

The chart shown in Fig. 1 covers all duct sizes since the scales may be taken to represent inches or feet, or multiples of either, provided such multiples are consistently carried through all scales.

Mathematically, the curves represent the graph of the family of curves given by Equation 1:

$$d = 1.265\sqrt[5]{\frac{(ab)^3}{a+b}} \quad \ldots\ldots\ldots\ldots\ldots 1$$

which is the formula used as a basis for all tables of circular equivalents presented in the HEATING, VENTILATING, AIR CONDITIONING GUIDE 1940.

For this application, Equation 1 is considered as an implicitly defined function between the two sides of the duct, a and b, with the diameter of the round duct d as a parameter.

By transforming Equation 1 and by substituting a new parameter K, the equation is simplified as follows:

$$\frac{(ab)^3}{a+b} = \left(\frac{d}{1.265}\right)^5$$

$$K = \left(\frac{d}{1.265}\right)^5 \quad \ldots\ldots\ldots\ldots 2$$

$$(ab)^3 - Ka - Kb = 0 \quad \ldots\ldots\ldots 3$$

The task of establishing the graph of this function with K [$K = f(d)$] as a parameter pre-

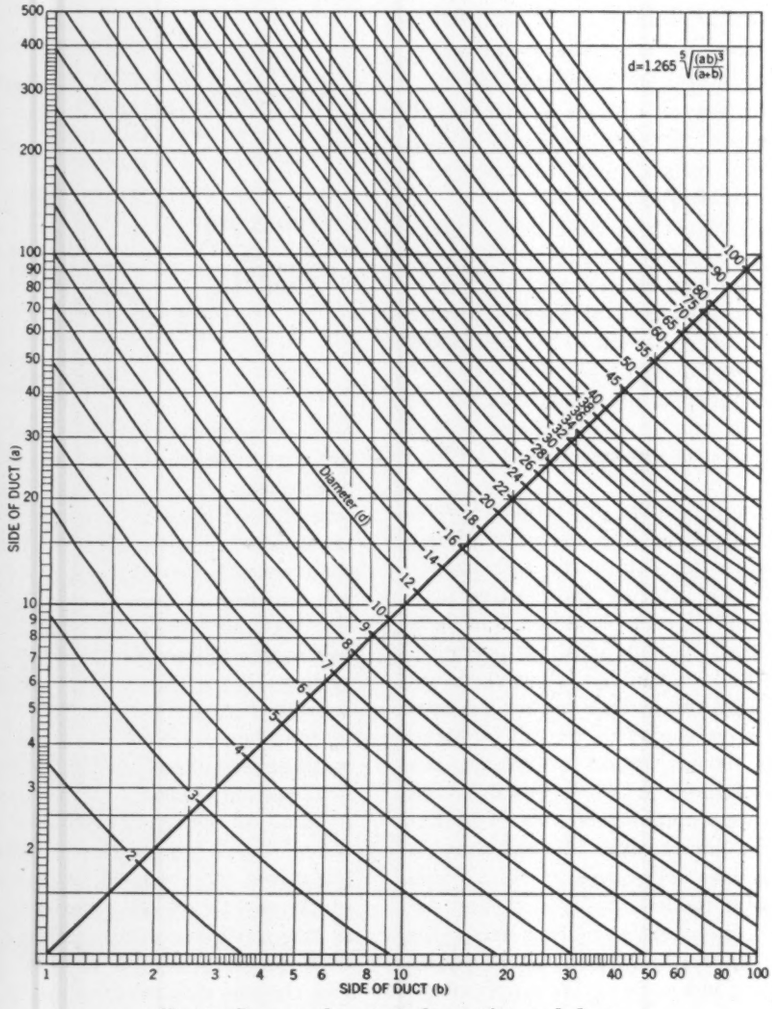


Fig. 1—Rectangular equivalents of round ducts

*Secretary, Tiltz Air Conditioning Corp.

sents difficulties, however, since the function is still only implicitly defined and of the third degree.

To effect a complete change in the appearance of the equation, the process of transformation is used. Instead of graphing the equation in the (ab)-plane as a function of a and b, the function is transformed into a function between two new variables x and y in a new plane, the (xy)-plane.

By defining x and y as given in Equation 4, a simplification of the function is effected:

$$x = ab;\ y = a + b \quad \ldots\ldots\ldots 4$$

$$x^3 - Ky = 0$$

$$y = \frac{x^3}{K} \quad \ldots\ldots\ldots 5$$

This function is simply a cubical parabola with the parameter $\frac{1}{K}$ which is sketched for the value $K = 1$ in Fig. 2. Similar curves may be constructed for all required values of K [$K = f(d)$].

There remains only the task of translating these curves in the (xy)-plane back into the (ab)-plane. This is accomplished by defining a and b in terms of x and y, in other words, by inversing the definitions given in Equation 4.

Simple arithmetics lead to the relationships:

$$a = \frac{y \pm \sqrt{y^2 - 4x}}{2};$$

$$b = \frac{y \mp \sqrt{y^2 - 4x}}{2} \quad \ldots\ldots\ldots 6$$

From these equations the points in the (ab)-plane corresponding to the points on a curve in the (xy)-plane may be determined and plotted in the (ab)-plane.

The apparent indeterminancy of the two equations as shown by the $\pm$ signs is caused by the symmetry of the original equation; it does not create any difficulties, as it would only spot two symmetrical points in the (ab)-plane corresponding to one point in the (xy)-plane. These points are symmetrical in the sense that one is obtained from the other by interchanging a and b (width and height of duct).

After an air duct system has been designed an engineer is often confronted with the problem of estimating the area and weight of ducts for ascertaining the economics of the installation. The weight of various gages and the area for any length of run of rectangular sheet metal ducts may be determined from Fig. 3. The bottom scale represents the sum of the two sides of the duct and the oblique lines give the length of run in feet. Proceeding longitudinally to the right from the intersection of the vertical and oblique lines on the chart, the area of the duct may be determined in the first vertical scale. This column of values is also useful in estimating the amount of insulation surface required to cover a duct used for carrying either heated or cooled air. The scales to the right give the weights of duct lengths for different gages of metal. Since all scales are logarithmic, multiples of 10 may be used on any scale provided this factor is taken into account when the final result is read from the chart.

It is believed that this method offers an accurate, simple and practical way to determine the rectangular equivalents and weights of ducts and that it will be welcomed by the practicing engineer.

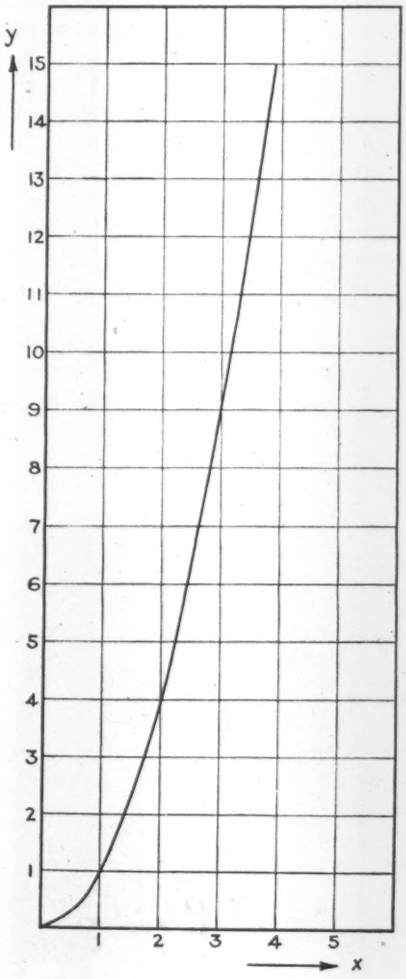


Fig. 2—Graph of parameter function

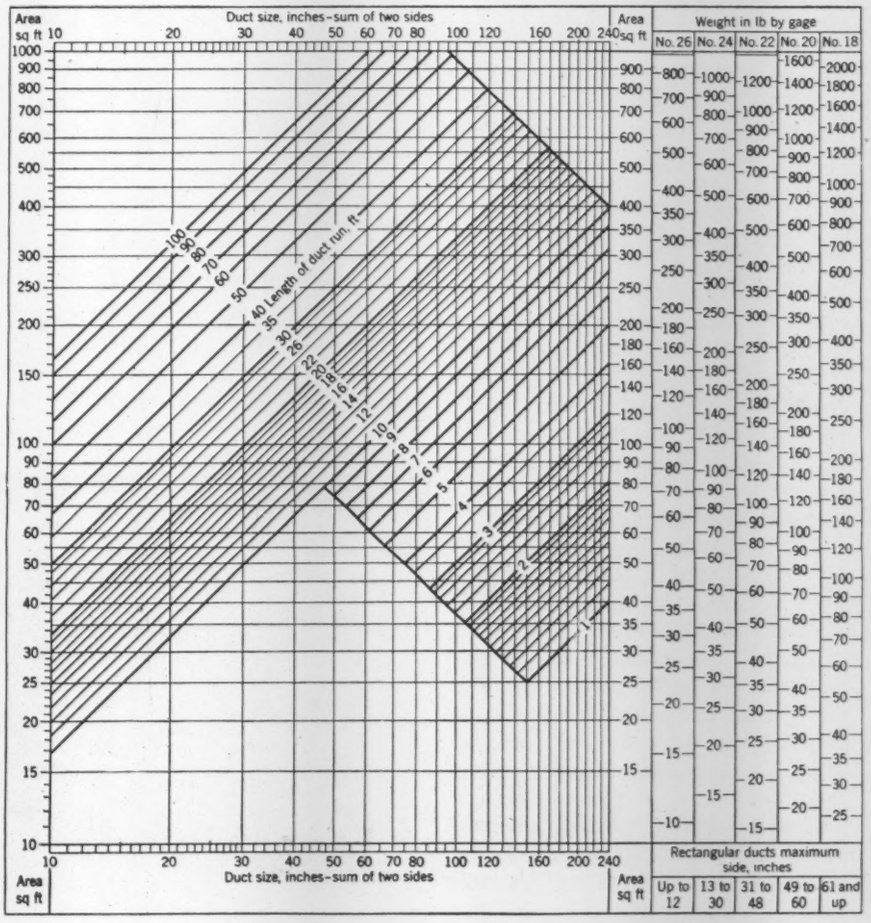


Fig. 3—Area and weight of rectangular sheet metal ducts

Kansas City in January

The Pioneer Mother

KANSAS CITY Chapter is making elaborate preparations for the Society's 47th Annual Meeting, January 27 to 29, at the Hotel Muehlebach. These members extend a cordial invitation to all members to come to the "Heart of America" for this important meeting.

The Program Committee has arranged for four Technical Sessions and offers a group of subjects for discussion that should be of interest to every member. Among the topics selected are: Comfort in High Altitude Flying; Friction in Fluid Flow; Comfort and Health and Temperature—A Mathematical Solution; Reheating by Means of Refrigeration Compressor Discharge Gas; A Laboratory Method for Cyclic Heat Measurements on Walls and Roofs; Operating Costs of Residence Wall Heating System; Radiation as a Factor in Comfort Requirements; Summer Cooling in Research Residence with a Gas-Fired Dehydration Cooling Unit.

The Committee on Arrangements is planning a program of entertainment that will be attractive to both members and ladies. Chairman J. M. Arthur announces that a reception will be held on Sunday evening for officers and members of Council and their wives. There will be an informal party Monday night and the Annual Banquet is scheduled for Tuesday evening at 7:00 p. m. Special events for the ladies are planned and there will be several inspection trips.

A conference of Chapter Delegates is scheduled for Monday morning and it is expected that each of the Society's 31 Chapters will name an official representative before January 1. A series of topical discussions is being arranged for this conference.

The Nominating Committee will hold its organization meeting and the Committee on Research and many technical advisory committees will meet and render final reports of the year's work.

The Council will hold a meeting on January 26, to clear all unfinished business. At the conclusion of the sessions on January 29, the organization meeting of the new Council will be held.

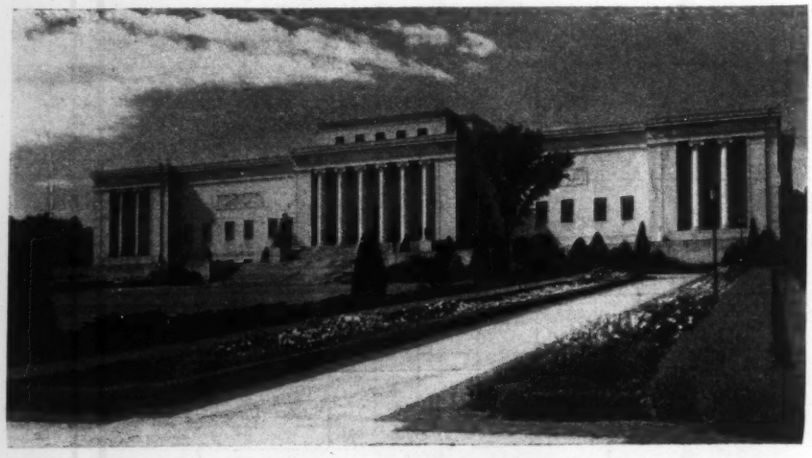
The Committee on Research and many of the 22 Technical Advisory Committees will hold meetings at 9:00 a. m. on Monday, January 27.

The reception of members and guests will commence at 1:30 p. m. Sunday, January 26. The Committee on Arrangements has planned for a welcome luncheon at 12:30 p. m. on Monday, January 27. The Entertainment Committee has arranged for a social hour at 6:00 p. m. and at 7:00 p. m. there will be an informal dinner and entertainment.

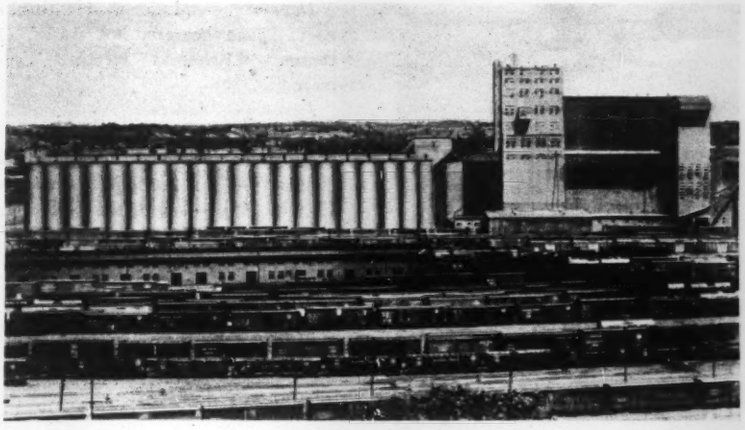
This 47th Annual Meeting offers interesting papers, important committee reports and an opportunity to meet old friends. Members should mark the dates on the calendar, January 27 to 29, and make their plans to attend.

Hotel reservation cards will be furnished and room rates at the Hotel Muehlebach are as follows: *Single room* with bath $3.00, $3.50, $4.00 per person per day; *Double room* with bath $5.00, $5.50, $6.00 two persons per day; *Twin beds* with bath $5.00, $6.00, $7.00, $8.00 two persons per day.

The Committee on Arrangements awaits the arrival of the Society in Kansas City and is ready to welcome all members to the "Heart of America."



The Wm. Rockhill Nelson Gallery of Art and Mary Atkins Museum



Large Kansas City grain elevator

TENTATIVE PROGRAM

47th Annual Meeting

American Society of Heating and Ventilating Engineers

Hotel Muehlebach, Kansas City

January 27-29, 1941

Sunday, January 26

1:30 p. m. Reception of Members and Ladies.
2:00 p. m. Council Meeting
6:30 p. m. Social Hour & Buffet Supper—Kansas City Club

Monday, January 27

8:30 a. m. Registration
9:00 a. m. Committee Meetings
9:30 a. m. Chapter Delegates Conference
12:30 p. m. Luncheon
2:00 p. m. TECHNICAL SESSION—
Reports of Officers and Council Committees
Fuels & Combustion—
(a) Boiler Testing Codes, by J. F. McIntire
(b) Warm Air Furnace Testing Codes, by F. L. Meyer
(c) Stoker Codes, by E. C. Webb
Comfort in High Altitude Flying, by D. W. Tomlinson
Report of Tellers of Election
6:00 p. m. Social Hour
7:00 p. m. Informal Get-together Dinner and Entertainment

Tuesday, January 28

10:00 a. m. TECHNICAL SESSION—
Report of Committee on Research—A. E. Stacey, Jr.
Friction in Fluid Flow, by F. E. Giesecke
Radiation as a Factor in Comfort Requirements, by F. C. Houghten, S. B. Gunst and J. Suciu, Jr.
Operating Costs of Residence Wall Heating System, by E. J. Rodee
2:00 p. m. TECHNICAL SESSION—
Comfort Requirements for Low Humidity Air Conditioning, by F. C. Houghten, H. T. Olson and S. B. Gunst
Comfort and Health and Temperature—A Mathematical Solution, by W. L. Fleisher and W. L. Fleisher, Jr.
Summer Cooling in Research Residence with a Gas-Fired Dehydration Cooling Unit, by A. P. Kratz, S. Konzo and E. L. Broderick
Reheating by Means of Refrigerant Compressor Discharge Gas, by S. F. Nicoll
7:00 p. m. Banquet and Dance

Wednesday, January 29

10:00 a. m. TECHNICAL SESSION—
A Laboratory Method for Cyclic Heat Measurements on Walls and Roofs, by F. G. Hechler and E. R. Queer
Heat Gain through Western Windows With and Without Shading, by F. C. Houghten and David Shore
1:30 p. m. Council Meeting

Fares to Kansas City

From	Railroad Round Trip—First Class	Pullman Lower One-Way	Coach Round Trip
Atlanta	$40.75	$ 6.30	
Cincinnati	36.20	5.50	
New Orleans	39.80	6.30	
San Francisco	75.60	13.95	
Chicago	20.70	3.15	$16.55
Urbana	20.35	2.65†	16.85
Des Moines	10.05	2.65	8.05
Omaha	9.00	2.65	7.20
Winnipeg	41.40	7.10	
Boston	75.70	10.25	
Detroit	37.35	3.15*	
Kalamazoo	29.15	3.15*	
Memphis	22.05	3.15	17.65
Rochester, Minn.	21.05	3.95	
Montreal	41.00	9.45	
New York	69.05	9.45	
Raleigh, N. C.	54.15	9.45	
Dallas	22.30	4.50	17.85
Houston	32.75	6.30	
Cleveland	40.55	5.80	
Oklahoma City	15.45	2.90	12.35
Toronto	31.55	7.10	
Buffalo	50.55	7.10	
Portland, Ore.	75.60	13.95	
Seattle	80.25	13.95	
Philadelphia	63.80	8.95	
Pittsburgh	47.20	6.30	
St. Louis	12.55	2.65	10.05
Los Angeles	75.60	13.95	
Washington, D. C.	58.10	8.95	
Grand Rapids	31.65	3.15*	
Milwaukee	23.35	3.15*	
Minneapolis	22.05	3.95	17.65

†From St. Louis. *From Chicago.

Committee on Arrangements

John M. Arthur, *General Chairman*
W. L. Cassell, *Co-Chairman*
A. D. Marston, *Vice-Chairman*
Registration—Henry Nottberg, Jr.
Reception—N. W. Downes.
Entertainment—L. A. Stephenson.
Housing—F. A. Sheppard.
Transportation—E. M. Jolley.
Banquet—W. L. Cassell.
Finance and Budget—Roger Campbell.
Publicity—F. F. Dodds, chairman.
Ladies—Mrs. William A. Russell.
Seeing-Kansas-City-Committee—Henry E. Gould.

Furnace Manufacturers to Meet in Detroit

The program for the 27th Annual Convention of the *National Warm Air Heating and Air Conditioning Association*, at Hotel Statler, Detroit, Mich., December 10 and 11, has been announced by Pres. C. A. Olsen. The program will include reports on the results of research investigations and discussions of merchandising, publicity and dealer education. Morning and afternoon sessions will be held during the two-day meeting.

San Francisco-Oakland Bridge with Treasure Island at right and Golden Gate Bridge in background

Meeting and Exposition on Pacific Coast in 1941

FOR the first time since its organization, the ASHVE will hold a meeting on the Pacific Coast when the Semi-Annual Meeting 1941 is called to order in San Francisco, Calif., June 16, at the Palace Hotel.

The Council has accepted the invitation of the Golden Gate Chapter and the Committee on Arrangements has been appointed by Pres. N. H. Peterson.

A gala program is promised for the week of June 16 and members of the entire heating, ventilating and air conditioning profession and industry on the Pacific Coast will have the opportunity of attending the Pacific Heating and Air Conditioning Exposition at the Civic Auditorium in San Francisco.

The Board of Directors of the *Heating, Piping and Air Conditioning Contractors National Association* has announced that the 52nd Annual Convention of that organization will be held in San Francisco, St. Francis Hotel, during the week of June 16. J. E. McNevin, Denver, President of the association, stated that this convention will give the contractors of the Pacific Coast region an opportunity to learn more about their national association and how it works and a chance to meet the officers and directors and the committeemen, who are responsible for carrying on the program of industry betterment which the association sponsors.

Southern California Opens Season

October 16, 1940. The Southern California Chapter held its first meeting at Steven's Nikabob Cafe, with 36 members and guests in attendance for dinner which preceded the meeting.

Pres. H. H. Douglas opened the meeting calling for a discussion regarding the activities of the chapter. A motion was made and voted upon, and it was agreed that the monthly meeting night would be changed to the second Wednesday in each month.

A. J. Hess, chairman of the program committee, outlined the year's program as follows:

November—"Aircraft Plants," heating, ventilating and air conditioning problems. National Defense.

December—"Modern Heating" — furnace, space heaters, hot water, electric, steam. "Christmas Meeting—Entertainment."

January—"Aircraft Air Conditioning" —suggested joint meeting with the Maintenance Engineers. Plumbing Inspector.

March—"An Architect Looks at Air Conditioning"—suggested joint meeting with the *ASRE*. Medical Profession.

February—"Motion Picture" — Round Table Questions—A. B. Wicks.

April—Presidential Meeting.

May—"Air Filters"—Boys' Work.

Mr. Hess then introduced Leo Hungerford, who reported on the happenings at the Society's Fall Meeting in Houston, Tex.

President Douglas introduced P. G. Caldwell, special products specialist, General Electric Co., who discussed and demonstrated special measuring devices, including dynamic balancing equipment, dewpoint indicator, lux meter, total lux meters, sound level indicator and many other testing devices.

According to Secretary Bullock's report a drive for new members was made and the members were asked to submit the names of prospective applicants for membership in the Society.

Unit Heaters Discussed at Ontario

November 4, 1940. The regular monthly meeting of the Ontario Chapter was held at the Royal York Hotel, and 50 members and guests assembled for dinner preceding the meeting, at which Vice-Pres. C. Tasker presided in the absence of Pres. J. W. O'Neill.

The minutes of the previous meeting were approved as written, and H. M. Treleaven, chairman of the Ask-It-Basket Committee, read questions and answers to various problems which had been submitted by members.

Mr. Tasker then introduced the principal speakers of the evening, Messrs. Dorfling, H. H. Angus, and M. W. Shears, all of Toronto. Each of these gentlemen spoke on unit heater applications, outlining various types, their respective application, methods of rating, types of motors used, etc.

Before the close of the meeting Mr. Dorfling was asked to read some of his own poems relating to the industry, which were extremely interesting.

W. C. Kelly extended a vote of thanks to the speakers for their splendid addresses, and this was followed by adjournment.

Joint Meeting Held at Michigan

October 9, 1940. The first regular meeting of the 1940-41 season of the Michigan Chapter was held at the L'Aiglon, with dinner preceding the meeting, which was attended by 46 members and guests.

The meeting was called to order at 7:30 by Pres. G. H. Tuttle, and the reports of the secretary and treasurer were read and approved.

J. F. McIntire, past president of the Society, introduced Prof. C.-E. A. Winslow, Yale School of Medicine, New Haven, Conn., and Mr. Parker, president of the Engineering Society of Detroit, who were dinner guests.

Vice-Pres. J. S. Kilner advised that the next meeting would be an inspection tour through the Detroit Sewage Disposal Plant.

F. X. Marzolf, chairman of membership committee, then presented his report on the membership status.

A proposed amendment to the By-Laws covering method of election of officers was presented by S. S. Sanford, and was referred back to the Board of Governors.

The meeting then adjourned to the auditorium of the General Motors Building where Professor Winslow addressed a joint meeting of the chapter and the Engineering Society of Detroit, on the subject of The Air-Cooled Human Body. After the address the usual question and answer forum of the Engineering Society was held, followed by adjournment.

Atlanta Discusses Trends in Air Conditioning Design

October 8, 1940. The regular meeting of the Atlanta Chapter was held at the Biltmore Hotel, with Pres. T. T. Tucker presiding, and 28 members and guests in attendance.

The research committee advised that Dr. Friedman of Georgia Tech reported that the research department of Georgia Tech had obtained approval by the faculty advisory committee of the attic fan project and that Georgia Tech had earmarked in excess of $1,000 as their part of the cost.

It was suggested that a plan be developed for encouraging the presentation of one or more papers at the chapter meetings by students of Georgia Tech, and the program committee was instructed to work out plans for this.

Following the report by the treasurer, I. C. Baker, vice-president in charge of sales, Chrysler Corp., Dayton, O., was introduced. Mr. Baker gave an interesting talk on the trends in air conditioning design throughout the country, which brought about a discussion which lasted over an hour, and Mr. Baker answered numerous questions put to him. According to Secretary Kent, there being no further business the meeting was adjourned.

Behavior of Metals Discussed at Minnesota Chapter

October 7, 1940. The October meeting of the Minnesota Chapter was held in Minneapolis, with an attendance of 85 members and guests for dinner, which was held in the recently completed Coffman Memorial Union on the campus of the University of Minnesota.

The meeting was called to order at 7:30 p. m., and the minutes of the September meeting were read and approved.

Pres. M. H. Bjerken then discussed briefly the membership directory which was recently distributed to members.

F. W. Legler, chairman of the entertainment committee, announced the plans for the annual chapter party held on November 4.

The speaker for the evening was Dr. Ralph Dowdell, professor of metallography at the School of Mines, University of Minnesota, who gave a very interesting talk on the subject of metals and their application in the field of heating and ventilating. Dr. Dowdell illustrated his talk, and described the characteristics of the various alloys and methods of determining their composition. The importance of proper thickness of metal when used in connection with air conditioning equipment was also stressed. Following some discussion the meeting adjourned.

Carnegie Tech Student Chapter

October 30, 1940. Twenty members and guests of the Carnegie Tech Student Chapter gathered for an inspection trip through the Grant Building, Pittsburgh, to examine the mechanical installations The heating system was inspected first and then several individual plants were explored, including garage ventilation, air conditioning units as installed on various floors, the elevator motor rooms, electric panel room and the air conditioning equipment for the studios of radio station KDKA. Here it was pointed out that extra precautions had been taken to insure a minimum duct noise so as not to disturb broadcasts.

As the interior of one entire floor was being fabricated the group was able to observe the different phases of building construction and installation. Explanations and discussions along the way made the inspection very interesting and educational.

At the conclusion of the tour the members and guests were taken to the observation deck, as the guests of the Building, and had a glimpse into Pittsburgh's atmosphere. According to H. S. Jones, secretary, the inspection was thoroughly enjoyed, and plans are under way for another helpful meeting next month.

Study of Defense Inventions

A committee organized to examine inventions useful in national defense, headed by Charles F. Kettering, Detroit, Mich., is seeking an appropriation with which to develop a staff of approximately 50 trained engineers, patent investigators and other experts to carry out its objectives.

Father and Son on *ASRE* Council

Louis S. Morse, Jr., Detroit, has been elected chairman of the Detroit section of the *ASRE* and automatically becomes a member of the Council which involves an unusual honor, as his father, Louis S. Morse, York, Pa., past president of *ASRE* is also a member of that Society's Council. This is said to be the first time in the history of the *American Society of Refrigerating Engineers* that both father and son are serving simultaneously as Council members.

CANDIDATES FOR MEMBERSHIP

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 18 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge the members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by December 16, 1940, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

CANDIDATES	REFERENCES	
	Proposers	*Seconders*
AMBROSE, ALFRED H., Student, Carnegie Institute of Technology, Pittsburgh, Pa.	C. M. Humphreys P. A. Edwards	T. F. Rockwell D. C. Saylor (*ASME*)
ASH, ROBERT S., Htg. Engr., James B. Clow & Sons, 201 N. Talman Ave., Chicago, Ill.	F. H. Gaylard N. P. Fenner	A. B. Martin M. W. Bishop
BEATTIE, JAMES, Htg. Contractor, Detroit, Mich.	C. F. Mally J. S. O'Gorman, Jr.	F. J. Feely F. J. Linsenmeyer
BEATTY, JOHN W., Student, Carnegie Institute of Technology, Pittsburgh, Pa.	C. M. Humphreys P. A. Edwards	T. F. Rockwell D. C. Saylor (*ASME*)
BOYD, LYLE E., Installation Mgr., Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.	E. M. Jolley A. J. Harton	Wm. A. Zurow F. L. Banner
BROWN, WINFRED E., Student, Iowa State College, Ames, Iowa	J. F. Sandfort R. A. Norman	R. E. Roudebush (*ASME*) M. P. Cleghorn (*ASME*)
FEHLIG, JOHN B., JR., Sales Mgr., Excelsior Heating Supply Div., Kansas City, Mo.	L. A. Stephenson C. Clegg	C. A. Weiss K. M. Stevens
FULLMAN, JAMES B., Mgr. Engrg. Service Dept., A. M. Byers Co., Pittsburgh, Pa.	F. C. Houghten W. R. Rhoton	B. R. Small F. C. McIntosh
HEYMSFIELD, HERBERT, Owner, Associated Service Co., Brooklyn, N. Y. (*Reinstatement*)	G. F. Olsen R. K. Raisler	J. M. Kipe A. J. Johnson
LEFFEL, PAUL C., Owner, The Leffel Co., Kansas City, Mo.	A. E. Williams W. L. Cassell	H. Nottberg, Jr. C. Clegg
MARINO, FRANK A., Owner, Corona Oil Burner Co., L. I., N. Y.	G. E. Olsen H. C. Roehm (*Non-Member*)	G. M. McCarthy (*Non-Member*) R. T. Demarest
NYQUIST, JOHN D., Student, University of Illinois, Champaign, Ill.	M. K. Fahnestock P. E. Mohn (*ASME*)	E. L. Broderick S. Sachs
POWERS, ROBERT W., Student, Carnegie Institute of Technology, Pittsburgh, Pa.	C. M. Humphreys T. F. Rockwell	D. C. Saylor (*ASME*) P. A. Edwards
RITTENHOUSE, OWEN R., Student, Carnegie Institute of Technology, Pittsburgh, Pa.	C. M. Humphreys T. F. Rockwell	D. C. Saylor (*ASME*) P. A. Edwards
ROBINSON, KENNETH E., Engr., McLouth Air Cond. Corp., Lansing, Mich.	B. F. McLouth L. G. Miller	C. H. Pesterfield H. B. Dirks (*ASME*)
ROSS, DAVID S., Student, Carnegie Institute of Technology, Pittsburgh, Pa.	C. M. Humphreys T. F. Rockwell	D. C. Saylor (*ASME*) P. A. Edwards
WATSON, G. M., Student, Iowa State College, Ames, Iowa	J. F. Sandfort M. P. Cleghorn (*ASME*)	R. E. Roudebush (*ASME*) R. A. Norman
YOUNG, ROBERT W., Sales Repr., Mueller Brass Co., Port Huron, Mich.	W. L. Cassell C. Clegg	K. M. Stevens L. A. Stephenson

CANDIDATES ELECTED

In the past issues of the JOURNAL of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by Art. B-III, Sec. 8, of the By-Laws, the following list of candidates elected:

MEMBERS

BATTAN, STUART W., Manager, S. W. Battan, Avondale, Pa.

BIRKETT, HAROLD S., Supv. Engr., Brooklyn Union Gas Co., Brooklyn, N. Y.

GAMMILL, OSCAR E., JR., Sales Engr., Carrier Corp., New Orleans, La. (*Advancement*)

HELWICK, N. J., Secy. & Engr., American Htg. & Plbg. Co., Inc., New Orleans, La. (*Advancement*)

SULLIVAN, TIM J., Pres., Sullivan Valve & Engrg. Co., Butte, Mont. (*Reinstatement*)

ASSOCIATES

GILBERT, THOMAS, Salesman, Empire Brass Mfg. Co., Ltd., London, Ont., Canada

MCCLOSKEY, JOHN H., Owner, J. H. McCloskey, Elkton, Md.

Heating·Piping and Air Conditioning

January-December, 1940—Vol. 12, Nos. 1-12

Published monthly by the Keeney Publishing Company, 6 N. Michigan Ave., Chicago, Ill.

As will be noted, these abstracts are classified under general heads. In looking for information on a specific subject, it will be well to look through the abstracts under the most suitable heading, and also to look through those under other headings. For example, some of the heating articles also contain information on air conditioning, and vice versa, *as the grouping has been made on the basis of the subject most prominently covered in the article.*

The index to the Journal Section *of the* American Society of Heating and Ventilating Engineers *is separate* (*see page* 759).

This index does not include Equipment Developments; Book Reviews; Booklets, Reports, and Papers; Recent Trade Literature; Conventions and Expositions; Schools and Study Courses—departments appearing regularly each month. The Editor's Pages in each issue include items of news, comments on current events, etc. In the January issue a complete directory section was published covering heating, piping and air conditioning equipment for industry and large buildings.

Air Conditioning

Absorption Refrigeration Used for Air Conditioning, by W. F. Friend
Vol. 12, *No.* 9. *September*, 1940. *p.* 551
Abstract of paper presented by W. F. Friend outlining progress in applying absorption refrigeration equipment for air conditioning service; elements of an absorption unit; services required; installations in use; corresponding rates for steam and electricity; saving by using absorption refrigeration; future development of equipment; absorption refrigeration worthy of encouragement.

Air Conditioned Brooms, by James M. Connolly
Vol. 12, *No.* 10. *October*, 1940. *p.* 598
("Open for Discussion"); Ace Broom Co., Brooklyn, N. Y., uses silica gel gas fired dehumidifier for preventing brooms from developing mildew and becoming discolored; unit will shortly pay for itself.

Air Conditioned Steamboat 'Round the Bend!, by J. H. Bailey
Vol. 12, *No.* 9. *September*, 1940. *p.* 542
Streamlined excursion steamer, S.S. *Admiral*, is air conditioned; centrifugal refrigerating machine; the air conditioning equipment; condensing water taken from river; insulation.

Air Conditioned Super-Market, by J. L. Rosenmiller
Vol. 12, *No.* 9. *September*, 1940. *p.* 547
Brief description of air conditioned market in Miami, Fla.; advantages of air conditioning a food market.

Air Conditioning a Modern Necessity
Vol. 12, *No.* 9. *September*, 1940. *p.* 526
Fifteen per cent higher rental charge in First National Bank Bldg., Birmingham, Ala. because of air conditioning; air conditioning considered as much a modern necessity as illumination.

Air Conditioning an Essential in Many Industrial Processes
Vol. 12, *No.* 6. *June*, 1940. *p.* 369
Brief paragraphs showing how air conditioning serves industry; has solved the problem of uniform gold leaf product for Hastings & Co., Philadelphia, Pa.; manufacture of nylon yarn and hosiery made possible by accurate control of temperature and humidity.

Air Conditioning an Essential in Many Industrial Processes
Vol. 12, *No.* 7. *July*, 1940. *p.* 420
Complaints and rejections on manufactured paper products reduced as result of installing two air conditioning units at Mead Corp., Chillicothe, Ohio; air conditioning playing increasingly important rôle in fruit growing industry.

Air Conditioning an Essential in Many Industrial Processes
Vol. 12, *No.* 8. *August*, 1940. *p.* 471
Color work on lithograph-metal sheets improved as result of air conditioning at the Federal Tin Co., Baltimore, Md.; why air conditioning is used.

Air Conditioning Attracts Tourists, by P. J. Rinderle
Vol. 12, *No.* 7. *July*, 1940. *p.* 412
New Orleans host to increasing number of summer tourists; winter and summer temperatures; number of air conditioning installations; types of buildings using air conditioning; comments of business men showing advantages of air conditioning the municipal auditorium, Roosevelt hotel, and Antoine's restaurant; picture of Canal St. showing air conditioned buildings.

Air Conditioning Combats Common Cold
Vol. 12, *No.* 2. *February*, 1940. *p.* 101
Report of address made by Dr. A. G. Young on the common cold and how and why air conditioning is of value in combating it; employee absences reduced by air conditioning.

Air Conditioning Contractor, The, by John H. Carter
Vol. 12, *No.* 3. *March*, 1940. *p.* 180
General discussion of air conditioning contracting organization; field of activity; potential volume; estimating the volume; overhead; functions of employees; the sales engineer.

Air Conditioning Contractor, The, by John H. Carter
Vol. 12, *No.* 5. *May*, 1940. *p.* 289
Contracting organization must do some engineering; good engineer means difference between profit and loss; the superintendent and his duties; importance of a good man; manager of the organization knits various functions together; qualifications the manager should have; promoting good will and its importance; capital requirements of the contracting organization.

Air Conditioning Contractor, The, by John H. Carter
Vol. 12, *No.* 8. *August*, 1940. *p.* 481
Value of using detailed cost estimating sheets; method of getting the total installed cost; allowing for "free service"; author suggests adding individual mark-ups for jobs of unusual type, or when the contracting organization is not too well experienced; cost estimating forms used by two air conditioning contractors.

Air Conditioning Design for Future Requirements, by Harry Boyd Matzen
Vol. 12, *No.* 11. *November*, 1940. *p.* 653
Description of new air conditioning system for May Co. department store, Cleveland, Ohio; air treating equipment in penthouses, refrigeration equipment in basement; system divided into five vertical zones; method of conditioning air, and control; two centrifugal water chilling units for flexibility; control centralized on panel board; air cleaned electrically; cooling tower arranged in three cells for flexibility and economy.

Air Conditioning for War, by Walter L. Fleisher
Vol. 12, *No.* 7. *July*, 1940. *p.* 31 *(front section)*
Importance of air conditioning plants producing war materials; air conditioning can do much to make it possible to produce more goods and goods of better quality; windowless air conditioned plants safer from air attack; temperature and humidity conditions which are desirable or necessary; location of plants in low wet bulb areas to allow evaporative cooling; floor area of average large plant; refrigeration capacity required; amount of air circulation; cost of air conditioning on per ton and per square foot bases; protection of air conditioning systems from damage; money should not be the factor to jeopardize preparedness program.

Air Conditioning for War, by R. S. Hawley
Vol. 12, *No.* 9. *September*, 1940. *p.* 543
("Open for Discussion"); comment on air conditioning for war; psychological effect of good working conditions in industrial plants; fan and duct system improves conditions in one case.

Air Conditioning Guards Knife Blades from Rust, by J. T. Schaefer
Vol. 12, *No.* 9. *September*, 1940. *p.* 547
Imperial Knife Co., Providence, R. I., installs unit air conditioners in stock room to protect pocket knives from rust due to moisture condensed from the air; heating coil used occasionally in summer.

Air Conditioning May Halt Decentralization in Cities
Vol. 12, *No.* 10. *October*, 1940. *p.* 588
Air conditioning solves problem of downtown smoke, dirt and noise and therefore is a factor in avoiding decentralization of downtown business districts with accompanying expensive obsolescence of downtown properties, according to E. M. McConney of Bankers Life Co., Des Moines, Ia.

Air Conditioning Plays Wartime Rôle in Ordnance Manufacturing Processes, by Harry Boyd Matzen
Vol. 12, *No.* 1. *January*, 1940. *p.* 1
Industrial process air conditioning essential in manufacture of such ordnance as high explosive shells, depth bombs, mines, time fuses, star shells, etc.; manufacturing process for ammonia nitrate; reactions involved; crystallizing room; temperature and vapor pressure conditions to maintain; size of plant built in 1918; manufacture of fuses and star shells; effect of moisture content on burning time; reasons for controlling temperature and relative humidity; importance of uniform conditions in manufacture of airplane parts during war of 1914-1918.

Air Conditioning Serves Mankind, by E. P. Heckel
Vol. 12, *No.* 10. *October*, 1940. *p.* 593
Early development of pharmaceutical manufacturing; cleanliness a prerequisite; air conditioning plays an important part; air conditioning systems recently installed for biological departments in Parke, Davis & Co.'s new laboratory

building, Detroit, Mich.; temperature and humidity conditions maintained; minimum air motion desirable; air doubly filtered; vibration isolation; how low air change with minimum air motion is achieved; induction type air discharge units.

Air Conditioning Serves New Industry, by A. T. Spangler and Fred Pederson
Vol. 12, *No.* 5. *May*, 1940. *p.* 298
Air conditioning maintains proper humidity and temperature conditions for domestic raising of chinchillas; installation at R. A. Graef ranch, Laurys, Pa.; conditions maintained; air conditioning equipment includes hot water heating coil and direct expansion cooling coil; oil burning boiler; air cooled and water cooled compressors; control.

Air Conditioning Service Engineer Outlines Method for Leak Testing, by Floyd M. Mayse
Vol. 12, *No.* 2. *February*, 1940. *p.* 114
Detailed outline of procedure for testing an air conditioning installation for leaks in the piping and equipment; diagram showing typical testing connections; method of using halide torch for detecting refrigerant leaks; final test of the installation.

Air Conditioning Sold at Auction
Vol. 12, *No.* 5. *May*, 1940. *p.* 294
Air conditioning equipment in Great Northern Hotel, demolished in Chicago, sold to Standard Club.

Air Conditioning Vital to Precision in Manufacture of Aircraft Engines
Vol. 12, *No.* 3. *March*, 1940. *p.* 151
Description of the air conditioned windowless factory of the Allison Division, General Motors Corp., Indianapolis, Ind.; need for air conditioning; general plant layout; design conditions; calculation of amount of air; type of air washers used; washer cells packed with glass strands; eight air washer units installed in penthouses; evaporative cooling used at times; air handling and distribution; 54 F well water available; "Freon" refrigeration machines; cold and hot water circulated in closed system with interchanger for cooling and interchanger for heating; air conditioning the office building; unit heaters in paint shop; exhaust ventilation for forging and casting cleaning department.

Air Duct Friction Chart, by Harold S. Morton
Vol. 12, *No.* 12. *December*, 1940. *p.* 721
(HPAC data sheet); chart combines all necessary information for air duct design; use of the chart for finding friction, velocity, cfm, diameter of round duct, width and depth of equivalent rectangular duct and friction loss in turns; value of using such a chart.

Annual Air Conditioning Review
Vol. 12, *No.* 1. *January*, 1940. *p.* 27
Comparative data tabulated on number of installations and connected horsepower for air conditioning commercial buildings, industrial plants and residences for 1938, the first 11 months of 1939, and totals as of December 1, 1939 for various cities; value of orders booked in 1939 and 1938 according to Department of Commerce figures; number of air conditioned railway cars; number of ice-using air conditioning systems; report of American Gas Association committee on air conditioning, recommending the industry make every effort to utilize existing marketing facilities.

Better Product by Air Conditioning, by O. F. Gilliam
Vol. 12, *No.* 6. *June*, 1940. *p.* 370
Application of air conditioning to smoke houses; temperatures and humidities; air distribution; plan of smoke house showing supply and return ducts; method of control; use of recorder-controller; advantages of air conditioned smoke houses.

Chain Store Air Conditioning Increases
Vol. 12, *No.* 12. *December*, 1940. *p.* 720
Expenditure for air conditioning by chain stores during 1940, according to survey by "Chain Store Age"; percentage of total spent for air conditioning; percentage of stores air conditioned during 1940 and previous two years.

Combination of Central Plant and Unit Air Conditioning Serves Varying Needs, by F. H. Chisholm
Vol. 12, *No.* 9. *September*, 1940. *p.* 539
How different requirements of Charity Hospital, New Orleans, La., are met; description of the institution; over 700 tons of refrigeration required; air conditioning the operating rooms; diagrams of typical central plant and controls, and typical room unit installation; autopsy amphitheater and morgue; ventilation of main building; central ammonia refrigeration plant.

Comparative Merits of Zoning Methods
Vol. 12, *No.* 10. *October*, 1940. *p.* 588
Table analyzing methods of zoning air conditioning systems presented by Walter A. Grant; advantages and disadvantages of the methods.

Conditioning Reduces Absenteeism, by Elliott Lee Ellingwood
Vol. 12, *No.* 9. *September*, 1940. *p.* 544
("Open for Discussion"); comments on value of industrial plant air conditioning; air conditioning reduces absenteeism due to sickness by 38 per cent; definite money saving by improving health conditions.

Contractors Hear Air Conditioning, Heating Committee Reports
Vol. 12, *No.* 7. *July*, 1940. *p.* 433
Committee reports presented at annual convention of Heating, Piping and Air Conditioning Contractors National Association; recommendations of air conditioning committee; selling and installing air conditioning coming to be recognized as strictly a contractor's problem; recommendations for consideration by the entire industry; report of committee on boiler output; new IBR testing and rating code; report of committee on standards; air chambers or tappings for convectors; proposal to request extension of convector testing code to require tests down to 120 F for hot water; specifications for metallic arc welding prepared by committee on welding; new officers.

Cost of Operating Air Conditioning System, by J. A. Gazelle
Vol. 12, *No.* 4. *April*, 1940. *p.* 230
Average amount of electricity, cost of water, sewer expense and maintenance cost for 24 hp air conditioning system at Alabama Power Co. offices, Mobile.

Dehumidifying and Heating Needed on an Industrial Conditioning Job, by Melvin A. Ramsey
Vol. 12, *No.* 9. *September*, 1940. *p.* 522
Air conditioning installation in rotogravure room of large Buenos Aires publisher; reheat needed in summer; warm condenser water used for reheating; heating in winter unsatisfactory, changes made in system; using condenser water for heating in winter; control; make-up water; diagram of system showing piping and controls.

Designing a Duct, by Gordon Midboe
Vol. 12, *No.* 9. *September*, 1940. *p.* 544
("Open for Discussion"); comment on answer to reader's question by Samuel R. Lewis published in April, 1940, HPAC; suggestions for solving the problem practically.

Designing a Duct, by F. F. Stevenson
Vol. 12, *No.* 10. *October*, 1940. *p.* 599
("Open for Discussion"); additional comment on letter of Gordon Midboe published in September, 1940, issue; friction loss in such a duct; balancing the duct.

Determining Power Requirements for Refrigeration Compressors, by Richard J. Panlener
Vol. 12, *No.* 5. *May*, 1940. *p.* 313
Formula for actual indicated horsepower of refrigeration compressors; determining the mean effective pressure; equations for calculating; comparison of results with different methods; explanation of inconsistencies; curves showing specific heat of ammonia vapor at constant pressure; basis of equations given.

Discoloration at Air Outlet Grilles Caused by Static Charges, Study Shows, by H. C. Murphy
Vol. 12, *No.* 1. *January*, 1940. *p.* 22
Discoloration of walls and ceilings at air outlet grilles caused by agglomeration of particles in ducts after air has passed through filters; agglomeration thought to be due to static electric charges; studies of the Underwriters' Laboratories; proper location of grilles and air intakes; dust counts taken at various floor levels at Woolworth building, New York, N. Y.

Double Standard of Comfort for Men and Women
Vol. 12, *No.* 9. *September*, 1940. *p.* 523
"Double standard" of comfort for men and women described by Prof. C. P. Yaglou; women invariably prefer higher temperatures; clothing habits partially responsible; desirable temperatures.

Du Pont Spends a Million for Air Conditioning
Vol. 12, *No.* 1. *January*, 1940. *p.* 10
Pictorial description of air conditioning installation at headquarters building of E. I. du Pont de Nemours & Co., Wilmington, Del.; size and area of building; per cent of total cost accounted for by equipment, dismantling and moving, alterations and additions to building; estimated operating cost 1½ per cent of salary roll; refrigerating equipment; central station units; prefabricated false ceilings; control and recorders.

EEI Survey Shows Spread of Air Conditioning
Vol. 12, *No.* 8. *August*, 1940. *p.* 476
Number of air conditioning installations and horsepower reported by 183 utility companies in survey issued by Edison Electric Institute; types of buildings in which air conditioning is most widely used.

57 F Ground Water for Condensing
Vol. 12, *No.* 3. *March*, 1940. *p.* 173
Ground water at temperature of 57 F used for condensing at air conditioned municipal court building, Philadelphia, Pa.; amount of water; capacity of cooling tower equipment not reduced.

Here's Where Air Conditioning Is Used
Vol. 12, *No.* 9. *September*, 1940. *p.* 547
Summary of air conditioning installations by business classifications as reported by operating utility companies; number of installations and horsepower for each classification as of December 31, 1939.

Horsepower Requirements of Refrigerating Compressors, by William Goodman
Vol. 12, *No.* 12. *December*, 1940. *p.* 711
Computing theoretical horsepower from tables of horsepower per cu ft of refrigerant vapor circulated simpler than using values of horsepower per ton; power requirements are divorced from refrigerating capacity; other advantages of tables of horsepower per cut ft; one suction temperature at which horsepower is a maximum; table showing horsepower per cu ft of vapor compressed per minute for "Freon-12"; formulas for computation of theoretical horsepower; example; curves showing brake horsepower for commercial compressors vs. suction temperature for three different refrigerants.

Hotel Air Conditioning, by Warren D. Lewis
Vol. 12 *No.* 6. *June*, 1940. *p.* 343
Air conditioning used to attract patrons and help hold them; most logical place for hotel air conditioning is the restaurant; business advantages of restaurant air conditioning; ballrooms and private dining rooms next in importance; reasons for not air conditioning lobby; importance of eliminating drafts, good control and thorough air cleaning; one hotel installation forces others; use of instruments; location of equipment; copper for washer pans and for baudelot

cooler; welded piping; cooling towers and evaporative condensers; New York City regulations require use of water conserving equipment; advantages of locating refrigerating plant on roof; use of ammonia.

Hotel Guest Room Air Conditioning Requires Good Engineering Design, by Warren D. Lewis
Vol. 12, *No.* 7. *July*, 1940. *p.* 417
The problem of prime importance is that the slightest noise may be noticed and complained about; use and limitations of portable air conditioners; many types of central systems; most desirable system is distribution of cool air to group of rooms from central unit, in author's opinion; method of air conditioning 250 guest rooms in Adolphus hotel, Dallas, Texas; refrigerating plant for chilling water in basement; unloading valves for "Freon" compressors; two central unit air conditioners on each floor; motors over-size; two ducts run down each corridor; desirable feature is ease of controlling air conditioning on individual floor; good control essential to success; instruments permit intelligent operation; cost of installation and operation; table showing air conditioning cost in dollars per room per day over a four months' period for "occupied" and "available" rooms.

How a Duct is Designed
Vol. 12, *No.* 4. *April*, 1940. *p.* 252
(Answer to a reader's question by Samuel R. Lewis); two recognized methods of designing ducts; constant velocity method; constant pressure drop method; examples; factors to apply for ducts of various materials. (Also see p. 544, September, 1940, issue.)

How Air Conditioning Serves Industry
Vol. 12, *No.* 11. *November*, 1940. *p.* 647
Description of new headquarters building of All-Steel-Equip Co., Inc., Aurora, Ill.; air conditioning considered essential; office portion is windowless; combination of well water and mechanical refrigeration used; air distribution; interior decoration combats adverse psychological effect of windowless space; noisy office equipment isolated in private rooms; projection type unit heaters for warehouse areas.

How Animals React to Air Conditions
Vol. 12, *No.* 10. *October*, 1940. *p.* 584
Excerpts from extensive paper by Dr. Samuel Brody, explaining effect of environmental temperature, humidity and air motion on various animals; reactions of sweating and non-sweating animals to hot and cold environments; metabolism; heat production; heat dissipation; air movement; adaptive powers to cold much greater than to heat.

How Much Power Is Used for Air Conditioning?, by Stephen L. Gregg
Vol. 12, *No.* 1. *January*, 1940. *p.* 19
Amount of horsepower per capita for air conditioning installed in various cities as of September 1, 1939; investigation made in Washington, D. C., of kilowatthours of electricity used per horsepower per season for air conditioning apartment houses, barber and beauty shops, drug stores, funeral parlors, hotels, movie houses, offices, stores and restaurants; data on storage refrigeration installation in theater—installed horsepower, maximum demand, power consumption and load factor; curves showing variation of degree days above 65 F and monthly kilowatthour consumption expressed as a percentage of the total for the season for drug stores; variation of degree days above 65 F for past six years for Washington, D. C.; need of education of operating personnel and use of instruments in promoting economy in air conditioning.

How the Courts Look Upon the Air Pollution Nuisance, by Lawrence R. Bloomenthal
Vol. 12, *No.* 2. *February*, 1940. *p.* 111
Review of various court decisions on air pollution and other nuisances; use of modern equipment; ordering installation of equipment; public interest involved; character of neighborhood affects decision; actual hazards; increasing the nuisance; disturbances at night; anticipating a nuisance; unreasonable complaints.

Ice Cools Democrats
Vol. 12, *No.* 8. *August*, 1940. *p.* 485
Cakes of ice used to cool Chicago Stadium during Democratic National Convention; ice placed in air washers.

Important Task for Air Conditioning, Shepard Tells ASRE
Vol. 12, *No.* 7. *July*, 1940. *p.* 424
The most important task which faces air conditioning industry is establishing in the public mind the need for air conditioning and the fact that the physical equipment is worth the price asked, according to John deB. Shepard at spring meeting of the American Society of Refrigerating Engineers; definition of luxury and necessity; engineering necessary to apply air conditioning; need for advertised prices for installations and for year 'round salesmen; effect of superheat on compressor performance discussed by E. R. Wolfert; investigation of cooling motors for air conditioning compressors; four methods considered; picking up motor losses by suction gas; conclusions.

Industrial Health Defense
Vol. 12, *No.* 9. *September*, 1940. *p.* 132 *(back section)*
Emergency reports issued by Air Hygiene Foundation to its member companies; fallacy of expecting output to increase in proportion to hours worked; potential toxic hazards; fatigue; value of records of sick absences; importance of methods of control for industrial hazards, such as exhaust systems.

Industrial Plant Air Conditioning and the National Defense Program, by Walter L. Fleisher
Vol. 12, *No.* 11. *November*, 1940. *p.* 646
Idea of building windowless air conditioned defense industry plants gains momentum; reasons for air conditioning; standards of temperature and humidity for comfort; air conditioning existing plants; use of well water.

Lake Water for Precooling
Vol. 12, *No.* 3. *March*, 1940. *p.* 158
Lake water used for air precooling and subsequently in refrigerant condensers at Church and Dwight Co., Syracuse, N. Y.; need for air conditioning; control.

Large or Small Temperature Rise Through Water Type Cooling Coils?, A, by F. F. Stevenson
Vol. 12, *No.* 10. *October*, 1940. *p.* 600
Cooling air by means of artificially chilled water; two schools of thought on water temperature rise through the coils; two systems compared; water velocity through coil; mean temperature difference; ratio of specific heats; surface temperatures of coils; other considerations; effect on refrigeration machine of reducing temperature of entering water; decreasing capacity of system; conclusions.

Large or Small?, by F. F. Stevenson
Vol. 12, *No.* 12. *December*, 1940. *p.* 716
Effect of large and small temperature rise through air conditioning coils on water chiller choice; comparison of two systems, one using a large and the other a small temperature rise; types of water chillers—full flooded, semi-flooded, and dry expansion; characteristics of each; control; refrigerant charge; mean temperature difference; comparison of chillers for the problem under consideration; conclusions as to the most suitable design; diagram of a typical water cooling system. (See also article by F. F. Stevenson in October, 1940, HPAC.)

Large Synchronous Motor Drives Air Conditioning Compressor
Vol. 12, *No.* 3. *March*, 1940. *p.* 162
Largest known synchronous motor powered from city network for air conditioning in operation at International building, Rockefeller Center, New York, N. Y.; description of motor; voltage maintained constant with induction type regulators; starting sequence; preventing vibration and noise.

Library Cleans Air Electrically, by T. J. Atkins
Vol. 12, *No.* 9. *September*, 1940. *p.* 134 *(back section)*
Brief description of electrical cleaning of air at new Virginia state library, Richmond; will protect book papers from deterioration.

Lighting and Air Conditioning
Vol. 12, *No.* 3. *March*, 1940. *p.* 140 *(back section)*
Review of paper on lighting and air conditioning presented at meeting of Chicago section of Illuminating Engineering Society by Howard M. Sharp; importance of lighting and air conditioning; two greatest responses of an individual to an environment are through the eyes and through the skin; effect of color in lighting; amount of heat from lighting; temperature rise in an office due to heat from lighting; ventilating lighting equipment to withdraw heat; new methods of lighting.

Maintenance of Plant Air Conditioning, by W. E. Lowell
Vol. 12, *No.* 2. *February*, 1940. *p.* 92
Discussion of various points in an industrial air conditioning system which need maintenance attention—outside air intake, coils, dampers, filters, spray chamber, nozzles, eliminators, strainers, ducts, air outlets, controls, wells; brief description of air conditioning for Miles Laboratories, Elkhart, Ind., where "Alka-Seltzer" is made; well water used for cooling; continuous narrow slots in ducts for air distribution; ammonia compressors; water on roofs reduces heat gain; checking and recording temperatures and humidities; use of flow meters.

Modernize Department Store with Zoned Heating, Air Conditioning, by A. E. Elgar
Vol. 12, *No.* 3. *March*, 1940. *p.* 175
Description of modernization of James McCreery & Co. store, New York, N. Y.; advantages of air conditioning a department store; centrifugal refrigeration machine driven by condensing steam turbine; chilled water circulated to 10 cooling and dehumidifying units; condensing water chemically treated; inside conditions maintained; relation to outside conditions; safety controls for turbine; heating system zoned; control board for heating system; daily log for air conditioning aids efficient operation.

More Air Conditioning for Gold Mines, by James A. Bentley
Vol. 12, *No.* 6. *June*, 1940. *p.* 347
Contract awarded for air conditioning system extending operations in Chris Shaft of the Robinson Deep gold mine, Johannesburg, South Africa; advantages of air conditioned gold mines.

New Features for World's Fair Air Conditioning Exhibit, by J. I. Lyle
Vol. 12, *No.* 5. *May*, 1940. *p.* 302
Brief description of features at "Weathermaker's Wonderland" exhibit at 1940 New York World's Fair; exhibit dramatizes the workings of air conditioning by comparing the human body to man-made air conditioning machines.

New York Air Conditioning Systems Must Have Water Saving Equipment
Vol. 12, *No.* 5. *May*, 1940. *p.* 294
Department of water supply, gas and electricity of New York City issues rules and regulations governing and restricting use of water for air conditioning and refrigerating; promote use of cooling towers and evaporative condensers; rules and regulations as issued.

Old Cooling and Ventilating System Converted to Up-to-Date Air Conditioning, by Henry W. Moore
Vol. 12, *No.* 5. *May*, 1940. *p.* 306
Description of modernizing Busse & Borgmann Co. funeral home, Cincinnati, Ohio; work included installation of mechanical refrigeration equipment for existing cooling and ventilating system, and self-contained air conditioning units in rooms not served by old duct system; location of equipment; use of well water; air distribution and circulation; control of system; diagram showing duct layout and equipment location.

Outdoor Temperature a Minor Factor in Air Conditioning Load
Vol. 12, No. 9. September, 1940. p. 526
Quotation from paper by Kendall B. Castle, Jr.; major portion of air conditioning load comes from sun heat, moisture removal and internal heat loads.

Piping Does Double Duty, by David E. Alton
Vol. 12, No. 9. September, 1940. p. 535
Unusual piping layout for air conditioning system serving Meyer Bros. Department Store, Paterson, N. J.; unitary zone design with independent zones receiving chilled and heated water from a central plant; main water system supplies chilled or heated water to main water coil in each zone; reheat system supplies heated water to the reheat coil, or city water to the sprays in each zone; general arrangement of piping; typical piping connections at each coil unit; changing from summer to winter operation; advantages of method.

Power Consumption and Operating Data for Storage Air Conditioning Presented, by J. M. Dean
Vol. 12, No. 3. March, 1940. p. 163
Discussion of advantages and disadvantages of refrigeration storage principle in air conditioning; electric utility's overhead costs on power for air conditioning; number of installations and horsepower in Des Moines, Ia.; storage type system installed for engineering and meter departments office space of Des Moines Electric Light Co.; calculation of size and design conditions; description of installation and schematic diagram; tests run; summary of test data and discussion of results—initial cost, conditions maintained, demand, heat transfer loss, power consumption; kilowatthour per ton per cooling hour factors for conventional jobs and storage jobs; offpeak rate compensation; suggestions to consider when designing and installing a storage system.

Predicting Dust Concentration, by Frank B. Rowley and Richard C. Jordan
Vol. 12, No. 12. December, 1940. p. 699
No quantitative methods of analysis available for determining degree to which use of filters will actually lower dust concentrations in enclosed spaces; factors which affect dust concentration; rate of air filtration; efficiency of air filtration; infiltration and exfiltration; internal dust sources; settling of dust; analysis of the rate of settling factor; formulas and equations.

Production for the Emergency and After, by J. I. Lyle
Vol. 12, No. 11. November, 1940. p. 662
Examples showing types of production problems, the solutions of which have been accomplished or aided by application of air conditioning; control of the physical reactions or properties of non-hygroscopic products; control of physical reactions or properties of hygroscopic substances; control of the rates and limits of chemical reaction in materials; control of physiological reactions for human efficiency, health and production, or in animal assay; control of biological or bacteriological reactions.

Properties of Mixtures of Air and Saturated Water Vapor for Barometric Pressures from 22 In. to 32 In. of Mercury, by William Goodman
Vol. 12, No. 3. March, 1940. p. 185
Table of properties of mixtures of air and saturated water vapor for 28 in. barometric pressure and for a temperature range from —40 F to +200 F.

Properties of Mixtures of Air and Saturated Water Vapor for Barometric Pressures from 22 In. to 32 In. of Mercury, by William Goodman
Vol. 12, No. 4. April, 1940. p. 253
Table of properties of mixtures of air and saturated water vapor for 29 in. barometric pressure and for a temperature range from —40 F to +200 F.

Properties of Mixtures of Air and Saturated Water Vapor for Barometric Pressures from 22 In. to 32 In. of Mercury, by William Goodman
Vol. 12, No. 5. May, 1940. p. 311
Table of properties of mixtures of air and saturated water vapor for 30 in. barometric pressure and for a temperature range from —40 F to +200 F.

Properties of Mixtures of Air and Saturated Water Vapor for Barometric Pressures from 22 In. to 32 In. of Mercury, by William Goodman
Vol. 12, No. 6. June, 1940. p. 373
Table of properties of mixtures of air and saturated water vapor for 31 in. barometric pressure and for a temperature range from —40 F to +200 F.

Properties of Mixtures of Air and Saturated Water Vapor for Barometric Pressures from 22 In. to 32 In. of Mercury, by William Goodman
Vol. 12, No. 7. July, 1940. p. 435
Table of properties of mixtures of air and saturated water vapor for 32 in. barometric pressure and for a temperature range from —40 F to +200 F.

Psychrometric Chart—Its Application and Theory, The, by William Goodman
Vol. 12, No. 1. January, 1940. p. 6
(Part 8); air mixtures; interpretation of ratio lines; variable moisture ratios; methods of solving problems involving mixtures of air; diagrammatic illustrations.

Psychrometric Chart—Its Application and Theory, The, by William Goodman
Vol. 12, No. 2. February, 1940. p. 107
(Part 9); temperature of adiabatic saturation; meaning of term "temperature of adiabatic saturation;" use of term "limiting temperature" suggested; demonstration that the well-known Carrier equation is a special case of a more general equation; percentage humidity; relative humidity and its relation to percentage humidity; psychrometric chart for normal barometric pressure, showing dry bulb temperature from 20 to 120 F and percentage humidities; examples of use of charts.

Psychrometric Chart—Its Application and Theory, The, by William Goodman
Vol. 12, No. 3. March, 1940. p. 171
(Part 10); use of specific volume of air in air conditioning computations; selection of equipment based on standard air but corrections for performance based on actual density of air; specific volume of air-vapor mixtures; specific volume lines on psychrometric charts; method of making calculations for humid air at high pressure; end points for wet bulb lines on psychrometric charts for barometric pressures of 23 and 24 in.

Psychrometric Chart—Its Application and Theory, The, by William Goodman
Vol. 12, No. 4. April, 1940. p. 239
(Part 11); geometry of the psychrometric chart; illustration showing construction of chart; variation in ratio angle with various moisture ratios; chart for normal barometric pressure with lines of constant wet bulb temperature instead of lines of constant enthalpy.

Psychrometric Chart—Its Application and Theory, The, by William Goodman
Vol. 12, No. 5. May, 1940. p. 303
(Part 12); appendices 1, 2, 3 and 4 showing derivation of equations given in text; tables of end points for wet bulb lines on psychrometric chart for barometric pressures of 25 and 26 in.; psychrometric chart for normal barometric pressure, giving lines of constant wet bulb temperature instead of lines of constant enthalpy.

Psychrometric Chart—Its Application and Theory, The, by William Goodman
Vol. 12, No. 6. June, 1940. p. 367
(Part 13); appendices 5, 6 and 7 showing derivations of equations given in text; tables of end points for wet bulb lines for barometric pressures of 27 and 28 in.

Psychrometric Chart—Its Application and Theory, The, by William Goodman
Vol. 12, No. 7. July, 1940. p. 431
(Part 14); appendix 8 showing derivation of equations used in connection with discussion of Figs. 32 and 34; skeleton psychrometric chart showing interpretation of horizontal distances when state point lies in fogged field of chart; tables of end points for wet bulb lines for barometric pressures of 29 and 30 in.

Psychrometric Chart—Its Application and Theory, The, by William Goodman
Vol. 12, No. 8. August, 1940. p. 486
(Part 15); publication of appendices and derivation of equations given in text concluded; tables of end points for wet bulb lines on psychrometric chart for barometric pressures of 31 and 32 in.

Railway Air Conditioning Problems
Vol. 12, No. 3. March, 1940. p. 142 (back section)
Review of paper on railway air conditioning problems presented by A. R. Walker before Chicago section of American Society of Mechanical Engineers; space and weight limitations; refrigerating capacity required; amount of air circulation; steam requirements for heating railway cars; average amounts of electrical and mechanical energy, steam and ice consumed by various railroad air conditioning systems; drawbar horsepower required for operation of railway car air conditioning; problems in railway car air conditioning; odors and ozone.

Regulating Condenser Water for Refrigeration Systems, by Alwin B. Newton
Vol. 12, No. 2. February, 1940. p. 95
Review of operating characteristics of different pressure control methods for regulating condenser water for refrigeration systems; factors affecting selection of type of control; simple pressure control; pressure control compensated by water temperature, by differential temperature, and by liquid temperature; diagrams of methods discussed.

Rental Rates for Air Conditioned Office Buildings
Vol. 12, No. 2. February, 1940. p. 116
Brief item reporting figures on effect of air conditioning on rental rates in office buildings in Chicago, Ill.

Should Hospital Operating Room Air Be Recirculated?
Vol. 12, No. 4. April, 1940. p. 251
(Answer to a reader's question); comments by Dr. Murray B. Ferderber, L. R. Flook, Charles F. Neergaard; recirculation should not be employed in operating rooms but may be used in other departments; recommendations of the Heating, Ventilating, Air Conditioning Guide.

Sold on Air Conditioning
Vol. 12, No. 12. December, 1940. p. 762
Map of State St., Chicago, showing the establishments which are air conditioned according to the number of floors conditioned; map prepared by air conditioning division of Commonwealth Edison Co.

Standard Fan Test, by C. W. Dexter
Vol. 12, No. 11. November, 1940. p. 657
("Open for Discussion"); first public demonstration of standard fan test adopted by NAFM and ASHVE given at air conditioning show sponsored by Commonwealth Edison Co.; illustration of test set-up.

Standby Power Questioned, by Lee P. Hynes
Vol. 12, No. 9. September, 1940. p. 543
("Open for Discussion"); need of standby power for operating air conditioning equipment questioned; air conditioning making a sound and steady growth; importance of roof insulation; emergency ventilation.

Steel Mill Cleans Air Electrically
Vol. 12, No. 5. May, 1940, p. 297
Electrostatic air cleaning apparatus for purifying ventilat-

ing air for motors being installed at Weirton Steel Co., Weirton, W. Va.

Sunshine Is Wonderful—Outdoors, by Les Avery
Vol. 12, No. 8. August, 1940. p. 477
Importance of reducing sun heat load in air conditioned buildings; recent development is a sun screen; informal tests made in suite of air conditioned offices; description of test set-up; curves showing temperatures on two different days with bare windows, venetian blinds and sun screen, together with the outside temperature; panel heating effect of venetian blind; further studies proposed; tables showing solar radiation in Btu per sq ft per hr transmitted through windows with and without sun screen for various latitudes; solar intensity incident to vertical surface.

Temperature, Humidity Affect Work Capacity
Vol. 12, No. 2. February, 1940. p. 113
Brief item on how temperature and humidity affect capacity of miners to do work; best average temperature for humans.

Ten Air Conditioning Commandments, by Willis H. Carrier
Vol. 12, No. 4. April, 1940. p. 246
Ten things not to do in promoting and selling air conditioning installations.

Theater Installs New Air Conditioning
Vol. 12, No. 2. February, 1940. p. 118
Savings in air conditioning operating costs obtained by replacing 15 yr old refrigeration plant at State Lake Theater, Chicago, Ill.; weight and floor space requirements.

Turbine Driven Centrifugal Machine Improves the Plant's Heat Balance, by W. S. Bodinus
Vol. 12, No. 9. September, 1940. p. 534
Centrifugal refrigeration machine driven by turbine makes the refrigerating unit an element in the complete heat balance of the plant; example of application in a brewery; other applications; use of mixed pressure type or bleeder type turbine; large savings possible.

Uniform Temperature and Humidity Protect Valuable Italian Exhibit
Vol. 12, No. 1. January, 1940. p. 5
Importance of maintaining uniform temperature and humidity for protecting Italian masterpieces on exhibit at Art Institute of Chicago; 48 radiator vent valve humidifiers installed for the galleries; method of installing valves along top of radiators; readings taken continuously; control of air circulation; brief description of winter air conditioning for new gallery wing.

Unusual Air Conditioning Problems, by Arthur J. Hess
Vol. 12, No. 10. October, 1940. p. 585
Air conditioning problems and methods of solving them in the motion picture industry; four general classifications of studio air conditioning—administrative division, sound stages, film laboratories, and film handling; requirements for administrative division installations; temperament of the artists and executives; importance of temperature control; sound stages present unique problems; size; insulation; light load; equipment design and capacities; air filtration; air distribution; reasons for controlling humidity; air velocities; a typical installation; description of air distribution; importance of automatic control; method of controlling cooling and humidification.

Ventilating and Heating a Chemical Lab, by Deane O. Hubbard
Vol. 12, No. 2. February, 1940. p. 106
Brief description of chemical engineering building at Case School of Applied Science, Cleveland, Ohio; problems to be solved in ventilating and heating; floor mounted heater-ventilator units; central station unit for large laboratory; preventing backdraft; construction of asbestos lumber ducts.

Ventilation of Air Raid Shelters, by Thomas C. Angus
Vol. 12, No. 6. June, 1940. p. 356
War has intensified need for mechanical ventilation in England; air raid shelters compulsory in some localities; gas-proofing rooms in dwelling houses; study made of carbon dioxide concentration, dry bulb temperature, wet bulb temperature, wall temperature and relative humidity in air raid shelters of steel and concrete construction; activated charcoal for purifying air; fans have alternative handle or bicycle mechanism drive.

Walt Disney Air Conditions, by Samuel Martin, Jr.
Vol. 12, No. 4. April, 1940. p. 231
Description of air conditioning of new studios of Walt Disney Productions, Burbank, Calif.; hot or cold water circulated to air conditioning units from central plant; 600 hp multiple condensing unit plant; well water also used for cooling in summer and heating in winter; animation building is the largest; method of air distribution; cleanliness important in camera building; air doubly filtered; method of supplying air to the stages; weather studies made; master indicating board shows temperatures and humidities; sound and noise given careful consideration.

Windowless Buildings Not New, by H. C. Murphy
Vol. 12, No. 11. November, 1940. p. 657
("Open for Discussion"); windowless buildings constructed in London in the 1600's to avoid window tax; ventilating system for Newgate prison installed in 1752.

Year 'Round Conditioning System for a Store Has "Three-In-One" Coil, by Joseph M. Aikman
Vol. 12, No. 2. February, 1940. p. 117
Description of air conditioning system for ladies' ready-to-wear store, Minneapolis, Minn.; mechanical refrigeration used instead of well as equipment can be moved; separate coil for each zone built in single casing; method of air distribution; summer control system; graph showing relation between inside and outside temperatures; winter control system; relative humidities maintained inside in winter to prevent condensation on single glass windows; floor plans of store showing location of equipment and ducts.

General

Air Raid Shelters Studied
Vol. 12, No. 10. October, 1940. p. 592
USHA studying air raid shelters for possible inclusion in low rent housing projects.

Directory Section of Heating, Piping and Air Conditioning Equipment for Industry and Large Buildings
Vol. 12, No. 1. January, 1940. p. 207 (back section)
Products classified, trade names and complete street addresses of manufacturers.

Engineering Preparation, by John Howatt
Vol. 12, No. 11. November, 1940. p. 656
("Open for Discussion"); this is an age of specialization; need for specialization in engineering; importance of vocational training to develop skill with the hands; national defense training program.

Heating, Piping and Air Conditioning Important Factors in National Defense
Vol. 12, No. 8. August, 1940. p. 31 (front section)
Comments by authorities on relationship between industrial heating, piping and air conditioning services and the national defense program; processes which require air conditioning discussed by E. P. Heckel; examples of uses of air conditioning in manufacture of war materials given by Willis H. Carrier; importance of modernization and maintenance of industrial plants at this time pointed out by W. A. Hanley; control of relative humidity and dust of ever increasing importance, according to Samuel R. Lewis; modernization of boiler and combustion equipment; defense housing; list of army and navy procurement offices issued by bureau of foreign and domestic commerce; G. J. Cummings recommends use of existing mechanical contracting organizations in connection with the defense program; efficiency and economy of the work will be promoted by so doing.

Housing for War Industry Workers
Vol. 12, No. 8. August, 1940. p. 492
Special survey on adequate housing for workers in war industries being made by the Twentieth Century Fund; importance of survey; objectives.

Human Body Just a Heating, Piping and Air Conditioning System
Vol. 12, No. 4. April, 1940. p. 242
Illustration of "human factory" display in Hall of Man, Buffalo Museum of Science, Buffalo, N. Y.; description of the "department of digestion" and of the "ventilating system."

In-Service Training Program Is of Benefit to School Engineers, by John Howatt
Vol. 12, No. 2. February, 1940. p. 90
Importance of school engineers keeping in touch with developments; need of stimulation in government employment; duties of school engineers classified; program for in-service training classes for school engineers conducted by Chicago board of education; extent and supervision of Chicago school system.

Man's Love of Round Numbers
Vol. 12, No. 10. October, 1940. p. 606
Abstract of article by P. G. Agnew, secretary of American Standards Association; why we like round numbers; pipe sizes; "preferred" numbers; reason for establishing them; proper method of rounding off numerical values; new ASA standard.

Show Section
Vol. 12, No. 1. January, 1940. p. 33
Complete description of and programs for Sixth International Heating, Ventilating and Air Conditioning Exposition, 46th Annual Meeting, American Society of Heating and Ventilating Engineers, and 44th Convention, National Warm Air Heating and Air Conditioning Association, January 22-26, Cleveland, Ohio; committee on arrangements; programs for meetings; list of exposition exhibits and products exhibited; layout of the exposition hall.

What Does National Defense Mean to You?, by T. H. Urdahl
Vol. 12, No. 9. September, 1940. p. 47 (front section)
Everyone has a part in the national defense program; what engineers and contractors can do; "politics"; construction contracts of negotiated fixed fee type; advantages and disadvantages of lumping several jobs under one contract; design and construction under one contract; contract fees; direct sub-contracts; administrative personnel; need for trained men.

Heating

Amount of Steam for Heating a Greenhouse Determined by Test, by G. K. Saurwein
Vol. 12, No. 3. March, 1940. p. 182
Condensate meter installed in greenhouse at Harvard University, Cambridge, Mass., to determine steam requirements for heating; description of greenhouse; tabulated results including Btu's of heat per day per deg temperature difference per sq ft of glass, and per cu ft of space; theoretical calculations check test results.

Attention to Details Cuts Cost of Heating and Other Services, by C. W. Kimball
Vol. 12, No. 1. January, 1940. p. 4
Experience at large hospital in Boston shows value of attention to details; brief description of plant; regular weekly inspections; detailed records of fuel, steam, electricity, water and laundry requirements and consumption; savings that have been made; table of comparative costs in percentages of total and cents per patient day for five successive years, for fuel, electricity, water, labor and supplies.

Boiler Ratings, by H. M. Hart
Vol. 12, *No.* 11. *November*, 1940. *p.* 657
("Open for Discussion"); comment on article on boiler ratings by Kalman Steiner and Fred Ravnsbeck published in October HPAC; net load recommendations of the Heating, Piping and Air Conditioning Contractors National Association.

Boiler Ratings, by J. B. Kingsley
Vol. 12, *No.* 12. *December*, 1940. *p.* 710
("Open for Discussion"); comment on article How Big Is A Boiler?, published in October HPAC; authors to be complimented; difference between SHBI and ASME method of measuring boiler heating surface; example of using the two methods; water tube boilers; additional comment by Kalman Steiner; obsolete terms such as boiler horsepower, boiler heating surface, and square feet of equivalent direct radiation should be abandoned.

Control Essential to Efficient Textile Mill Heating, by Henry F. Perkins
Vol. 12, *No.* 2. *February*, 1940. *p.* 89
Reason for locating heating coils on ceiling in textile mill; importance of automatic control; waste with hand control; necessity of uniform temperatures and humidities.

Corrosion in Steam Heating Systems, by Leo F. Collins with Everette L. Henderson
Vol. 12, *No.* 1. *January*, 1940. *p.* 24
(Part 5); analyses of steams produced in 12 different boiler plants; tolerable limits for oxygen and carbon dioxide; sources of entrained gases; content of oxygen and nitrogen in water in contact with atmosphere at various temperatures; data on solubility of CO_2 in pure water; dissolution of air in pure water; carbon dioxide content of feedwaters; problem of CO_2 elimination; removal of CO_2 from sodium bicarbonate solutions; relation of hydrate/carbonate content in hard boiler water and CO_2 in steam.

Corrosion in Steam Heating Systems, by Leo F. Collins with Everette L. Henderson
Vol. 12, *No.* 2. *February*, 1940. *p.* 99
(Part 6); four experimental studies on removal of carbon dioxide by feedwater treatment; aeration with spray nozzles; experiments with acid zeolite and aeration; aeration in a bubbling tower; steam distillation experiments; apparatus and results of studies diagrammed and tabulated.

Corrosion in Steam Heating Systems, by Leo F. Collins with Everette L. Henderson
Vol. 12, *No.* 3. *March*, 1940. *p.* 159
(Part 7); data on removal of oxygen and carbon dioxide from feedwater on four typical installations; non-deaerating open feedwater heater; tray type deaerating feedwater heater; atomizing type deaerating feedwater heater; tabular analyses of performance; sketches of installations; discussion of results obtained.

Corrosion in Steam Heating Systems, by Leo F. Collins with Everette L. Henderson
Vol. 12, *No.* 4. *April*, 1940. *p.* 243
(Part 8); feedwater treating system at Congress St. heating plant of The Detroit Edison Co.; description of the old feedwater cycle; first endeavor to improve it; the new cycle; comparative conditions in the cycle under various operating conditions; preparation of the dilute acid used; acid proportioning equipment; adjustable orifice; aerating tower; caustic feeding system.

Corrosion in Steam Heating Systems, by Leo F. Collins with Everette L. Henderson
Vol. 12, *No.* 5. *May*, 1940. *p.* 299
(Part 9); operation of feedwater treating system at Congress St. heating plant of Detroit Edison Co.; diagram of feedwater cycle; data typical of variations which normally occur at key points in the cycle; control of the system; operating experiences and results; effect of quantity of air passed through degasifier on free CO_2 in the water after aeration; relationship between water temperature and free CO_2 content of aerated water; comparative operating costs of feedwater treatment; bibliography of references on corrosion.

Cost of Factory Heating, by Samuel R. Lewis
Vol. 12, *No.* 10. *October*, 1940. *p.* 599
("Open for Discussion"); answer to reader's question for information on approximate installation costs of heating systems in factories in New England area.

Cost of Steam With Coal as Fuel, by Irving E. Brooke
Vol. 12, *No.* 9. *September*, 1940. *p.* 537
(HPAC data sheet); chart shows cost of steam in cents per thousand pounds using coal of various Btu values for various costs of coal and efficiencies; chart also shows evaporation in lb of water per lb of coal, and lb of coal per boiler hp-hr; advantage of this chart; use of chart.

Cost of Steam With Gas as Fuel, by Irving E. Brooke
Vol. 12, *No.* 11. *November*, 1940. *p.* 669
(HPAC data sheet); chart shows cost of steam in cents per thousand pounds using gas of various Btu values for various costs of gas and efficiencies; chart also shows evaporation in pounds of water per thousand cubic feet of gas and cubic feet of gas per boiler horsepower-hour; second chart shows relationship between cost of gas in cents per thousand cubic feet and in cents per therm.

Cost of Steam with Oil as Fuel, by Irving E. Brooke
Vol. 12, *No.* 10. *October*, 1940. *p.* 615
(HPAC data sheet); chart shows cost of steam in cents per thousand pounds using oil of various Btu values for various costs of oil and efficiencies; chart also shows evaporation in lb of water per gal of oil, and gal of oil per boiler hp-hr; advantage of this chart; use of chart.

Daily Degree Day Check Saves Heating Steam, by R. E. Hieronymus
Vol. 12, *No.* 12. *December*, 1940. *p.* 707
Survey of office buildings shows importance of making daily degree day check of steam consumption as contrasted with no check, or a monthly check only; actual example shows reduction of 33 per cent in steam consumption for a Chicago building; description of a widely used chart; how it is used and its advantages; establishing the initial allowance for amount of steam for heating, according to various outside temperatures; study of average temperatures in building made with portable recording thermometer; results plotted; what the chart indicates may be done toward achieving heating economy.

Deaerating Heaters at Hospital, by Irvin H. Geiger
Vol. 12, *No.* 10. *October*, 1940. *p.* 599
("Open for Discussion"); illustration and brief description of two deaerating heaters for removing dissolved oxygen and heating domestic service water in Harrisburg, Pa., state hospital.

Design and Installation of a Central Hot Water Heating Plant, The, by C. G. Wohlfarth
Vol. 12, *No.* 7. *July*, 1940. *p.* 413
Description of heating Chatham Park apartment village, Chicago, Ill.; central hot water heating plant furnishes requirement of 26,500,000 Btu per hr; four stoker fired steel boilers; outside compensating thermostat; prefabricated insulated pipe for underground system; method of installation; anchoring; separate piping circuits for building groups; direct return system for north group, and reverse return system for south group; pressure differential control valves installed in group circuit supply main for north group; single main building circuits; special shunt fittings; plugged tees for connecting flow meter for balancing; method of sizing mains; convectors of special design; cast iron concealed radiant convectors in bathrooms; method of supplying domestic hot water; shell and tube heaters.

Direct Fired Units Heat Armor Plate Plant, by David Henderson
Vol. 12, *No.* 8. *August*, 1940. *p.* 479
Brief description of reconditioning of navy armor plate plant, South Charleston, W. Va.; machine shop and boiler house segregated as far as heating is concerned; 22 floor type gas fired air heaters to be installed; location of heaters.

District Heating Association Holds Meeting at French Lick
Vol. 12, *No.* 6. *June*, 1940. *p.* 372
Review of several committee reports presented at annual meeting of National District Heating Association; standardization of the degree day; use of degree day values from weather bureau recommended; control of 140 ton steam jet refrigeration installation; condenser water for steam jet air conditioning; maintenance of thermostatic traps on radiators and riser traps; inspection and cleaning; steam loss from underground main; study of heating economies; district heating "highlights" of 1939; officers elected.

Electric Elements Well Adapted to the Air Conditioning Heating Cycle, by Lee P. Hynes
Vol. 12, *No.* 1. *January*, 1940. *p.* 29
Necessity of zoning air conditioning system in a building; difficulties of controlling temperature of air to various rooms; advantages of electric heat for the entire heating cycle or as booster heat elements in local branch supply ducts; description of all-electric heating cycle for air conditioned office building of Appalachian Electric Power Co., Beckley, W. Va.; heating and air conditioning the garage, the auditorium, and the lobbies and offices; difference between electric and steam heating and how it affects control.

Eleven Ways Heating Has Been Improved, by Lewis W. Mauger
Vol. 12, *No.* 3. *March*, 1940. *p.* 174
Eleven examples of how heating in various buildings has been improved; chimney effect in tall buildings; weatherstripping doors; weatherstripping windows; use of quick vent valves at tops of steam risers; defective trap elements; advantages of vacuum heating; combining heating plants of adjoining buildings; changing from high pressure to low pressure operation; setting oil burners and stokers; importance of proper size combustion chambers for oil fired jobs; savings with barometric dampers; stoker firing increases capacity of plant; importance of meters and instruments for draft, CO_2, flue gas temperature, outside temperature, inside temperature, flow of fuel oil, etc.

Florida Hotels Install Heating, by John B. Swift
Vol. 12, *No.* 4. *April*, 1940. *p.* 238
Severe winter in Florida makes it necessary for unheated hotels to install heating equipment; electric heat in some form appears to be the answer in older buildings; even open air amusement places use heating; Miami dog racing track installs unit heaters.

Foreign Experiences with Radiant Heating, by Stephen Zamenhof
Vol. 12, *No.* 2. *February*, 1940. *p.* 98
Abstracts of foreign articles on panel or radiant heating; in new French system, warm air introduced directly under ceiling warms the ceiling; sketch; use and extent of radiant heating in Bohemia; investigation of ceiling panel radiant heating plant in Danish school; heat consumption; comparison with conventional radiator heating plant; temperatures.

Gas Engine Driven Generator Improves Operation at Franklin Heating Station, by Neil D. Adams
Vol. 12, *No.* 11. *November*, 1940. *p.* 643
Franklin heating station serves power and steam requirements of various properties in Rochester, Minn.; natural gas by pipe line from Texas; performance of boiler using pulverized coal; fly ash; change-over from pulverized coal to natural gas; diagram of combination gas and coal burner; advantages of using gas; peak electrical demand increases; gas engine driven generator installed; can be converted to oil; performance and operation tests; diagram showing water circulation at heating station.

Getting Boilers Into a Tight Spot, by Edwin A. Kingsley and R. Stewart Bruns, Jr.
Vol. 12, *No.* 5. *May*, 1940. *p.* 291
Description of installation of boilers for heating Beaux Arts apartments, New York, N. Y.; steam formerly purchased from outside source; major problem in constructing boilers so they could be gotten into the new boiler rooms; description of boiler construction; method of installing boilers; rolling the tubes; construction of the stacks; boilers oil fired; section through one of the boiler rooms.

Hangars at New York Airport Heated with Warm Air System
Vol. 12, *No.* 3. *March*, 1940. *p.* 183
Description of heating hangars at New York City municipal airport at North Beach, Queens, Long Island; size of hangars; oil fired direct air heaters used; size of heaters; test results; air distribution; temperatures maintained; diagram of heating of seaplane hangar; administration buildings heated by low pressure steam systems; air conditioning for office spaces; central refrigerating plants.

Heating Abroad and at Home, by Sam Lewis
Vol. 12, *No.* 9. *September*, 1940. *p.* 554
Comparison of heating practice in the United States and England; design temperature differences; welding piping; use of copper tubing; nomenclature used in England and in United States; scotch marine boiler known as "economic" boiler in England.

Heating a Garden Apartment Project, by Herbert Raisler
Vol. 12, *No.* 9. *September*, 1940. *p.* 553
Description of heating Interlaken Gardens, Eastchester, N. Y.; project divided into five groups each having one building designed to contain a boiler plant; forced hot water heating system; oil fired scotch marine boilers; water circulation; control; clock operated night control.

Heating by Reversed Refrigeration, by A. J. Lawless
Vol. 12, *No.* 8. *August*, 1940. *p.* 473
Description of reversed refrigeration heating and complete air conditioning system for United Illuminating Co. administration and service building; principle of the reversed cycle; two natural sources of heat which can be used; cost of electricity; factors affecting practicability of reversed cycle heating system; heat obtained from well water; the general heating and cooling scheme; flow diagram showing the entire heating and cooling system.

Heating by Reversed Refrigeration, by A. J. Lawless
Vol. 12, *No.* 9. *September*, 1940. *p.* 519
Reversed refrigeration cycle used for heating administration and service building of United Illuminating Co.; well water the source of heat; controlling operation of well pumps; refrigeration plant; compressor controls; interconnecting piping; basis of heating design; heating control; heating and ventilating garage areas; zoning; electrical boosting system for offpeak operation; changing from heating to cooling; circulation of well water.

Heating New Air Ministry Headquarters in London
Vol. 12, *No.* 3. *March*, 1940. *p.* 170
Pictures and brief description of method of heating new Air Ministry Headquarters building, London, England; forced circulation hot water heating system; panel type radiators; stoker fired boilers; heating pumps (also see p. 350, June, 1940.)

Heating of Rockefeller Center, The, by J. H. Rawson and C. W. Walton, Jr.
Vol. 12, *No.* 4. *April*, 1940. *p.* 221.
Original concept of Rockefeller Center, New York, N. Y., completed this year; heating problem is that of combining large scale operation with flexibility; sub-atmospheric steam used; steam purchased; zoning the buildings; radiation of convection type; method of controlling the heating system; temperatures maintained; ventilation of offices.

Heating, Ventilating and Air Conditioning on Shipboard, by John H. Clarke
Vol. 12, *No.* 8. *August*, 1940. *p.* 467
Three outstanding periods in shipbuilding during the last 20 years; older methods of shipboard heating, ventilating and air conditioning; the Maritime Commission program; features of the present program; many problems encountered in marine work; effect of safety regulations; low head room; recirculating air; location of intakes; fan location; weight and cost of equipment; air filtering; flue gas from stacks; types of ventilation systems used on ships—split system, central system, dual duct system, unit system; applications, advantages and disadvantages of each; air conditioning of public spaces; use of electric heaters.

Heating, Ventilating and Air Conditioning on Shipboard, by John H. Clarke
Vol. 12, *No.* 9. *September*, 1940. *p.* 529
Types of exhaust systems used on shipboard; methods of control; stratification; sizing control valves; location and setting of thermostats; sketches of control arrangements; manual control unsatisfactory; ventilation of machinery spaces; ventilation for cargo holds; need for dehumidification of holds; silica gel dehumidification equipment; method of operation.

Heating, Ventilating and Air Conditioning on Shipboard, by John H. Clarke
Vol. 12, *No.* 10. *October*, 1940. *p.* 610
Amount of air circulated in spaces on shipboard; temperatures maintained; details of duct construction; duct velocities; high velocity terminals; types of fans used; fan capacities; fan motors; heating and cooling surface; air filters; humidification; insulation; basis of heating design; pressure drop in steam lines; steam piping and specialties; air conditioning equipment; controls; refrigerant and brine piping.

How Big Is a Boiler?, by Kalman Steiner and Fred Ravnsbeck
Vol. 12, *No.* 10. *October*, 1940. *p.* 595
Disparity exists between various methods of rating heating boilers; what is boiler heating surface?; bases of the various rating codes; relation between boiler heating surface and boiler output; hot water heating boilers; high pressure boilers; cast iron boilers; converting to mechanical firing; performance curves for oil fired steel boiler; importance of proper chimney design when boilers are expected to carry overloads; importance of the subject.

How Manager Keeps Track of Building Temperatures
Vol. 12, *No.* 4. *April*, 1940. *p.* 224
Office building manager has two thermostatically controlled lights in his office operated by rising or lowering temperatures in a typical location; similar light arrangement in boiler room aids operating personnel, particularly in warming up the building.

How Much Steam for Heating?, by Earle Shultz and J. C. Butler
Vol. 12, *No.* 9. *September*, 1940. *p.* 545
Highlights of study made by joint committee on heating economies of the National Association of Building Owners and Managers and the National District Heating Association; studies made on buildings purchasing steam and on buildings producing steam; effect of type of heating system on steam consumption; effect of type of control; effect of type of occupancy; charts showing office building heating steam requirements per degree day depending upon building volume and hours of occupancy, and comparing heating steam consumption on degree day and building volume basis for different types of occupancy.

How to Choose Economical Fuel for Heating Boilers, by Paul R. Unger
Vol. 12, *No.* 5. *May*, 1940. *p.* 295
Charts for analyzing the cost of generating 1000 lb of steam for coal at various prices per ton, heat content and for various efficiencies; gas at various prices per 1000 cu ft and per therm, various heat contents and efficiencies; oil at various prices per gal, heat contents and efficiencies; discussion of making fuel cost analysis; cost of generating steam other than fuel cost; flexibility of operation is worth money; stability or instability of the fuel market; combination plants for burning more than one fuel.

How We Improved the Heating of Our Plant, by H. A. Richardson
Vol. 12, *No.* 4. *April*, 1940. *p.* 235
Description of modernization of the heating system for a mill of the Phoenix Silk Corp.; troubles with the old system; importance of uniform temperatures to manufacturing efficiency; charts from recording thermometers show temperatures maintained before and after improvements; piping changes; operation of the new system; minor operating difficulties, particularly with thermostats; changes paid for by savings.

It's All Done With Mirrors
Vol. 12, *No.* 11. *November*, 1940. *p.* 658
C. D. Scott of the Foreman building, Los Angeles, Calif., uses several mirror devices in his boiler room; mirror shows whether gas burner of vertical boiler is on; periscope arrangement at bottom of 200 ft stack to show whether stack conditions are correct.

Method for Approximating the Steam Required for Heating Water, A
Vol. 12, *No.* 4. *April*, 1940. *p.* 252
Method of estimating percentage of total steam used by an office building for heating the domestic service water; application of the method.

Methods of Establishing *k* Values—How Heat Conductivities Have Been Determined, by Kalman Steiner and Sydney D. Black
Vol. 12, *No.* 1. *January*, 1940. *p.* 49
Methods utilizing plates, spheres and prisms in determining heat conductivity values; continuous flow methods; hot box, hot plate and Nicholls heat meter; sketches of various laboratory set-ups.

Modern Heating and Ventilating, by Meryl L. Todd
Vol. 12, *No.* 10. *October*, 1940. *p.* 607
Description of heating and ventilating system for Longfellow elementary school, Waterloo, Ia.; automatically operated boiler room; zoned central heating and ventilating system; boiler room is watertight due to possible flood conditions; coal handling; coal fed automatically from bin to boilers; the stokers; two steel boilers; ash conveyor; hot water boiler for burning refuse; the heating and ventilating system; ducts; watertight dampers in ducts. (also see p. 659, November issue).

New Plant Heated by Steam and Hot Water
Vol. 12, *No.* 3. *March*, 1940. *p.* 184
Brief description of heating new plant of Toledo Scale Co. near Toledo, Ohio; overhead steam unit heaters for factory portion and forced hot water radiator system for office section; control of unit heaters; reason for using hot water system; control of hot water system.

Northwestern Builds Technological Institute
Vol. 12, *No.* 9. *September*, 1940. *p.* 536
Brief description and illustration of new Technological Institute of Northwestern University, Evanston, Ill.; heated by forced hot water circulated through convector radiation; steam used for indirect heating units; steam obtained from university's power plant; pipe; underground laboratories air conditioned; temperatures and humidities to be maintained.

Panel Heating, by Edwin A. Jones
Vol. 12, *No.* 11. *November*, 1940. *p.* 657
("Open for Discussion"); comment on article by F. E. Giesecke in October HPAC; use of warm air for panel or radiant heating temperature difference between entering and leaving air; application of air blanket panel idea to parts of rooms where conventional systems fail to provide comfort.

Panel Heating Construction
Vol. 12, No. 6. June, 1940. p. 350
Description and detail of floor panels and panel type radiators for forced circulation hot water heating system at Air Ministry Headquarters, London, England; installation illustrated and briefly described in March, 1940, HPAC.

Panel Heating with Warm Well Water, by Erwin L. Weber
Vol. 12, No. 12. December, 1940. p. 714
Service and repair garage in Klamath Falls, Ore., has panel heating system; pipe coils are in floor of garage portion in order to create efficient working conditions; ceiling coils used in office section; warm well water available in this region used for heating; drawings showing transverse section through building, section through well, and the pump and connections; photos of floor coils.

Panel Warming and Cooling, by Erwin L. Weber
Vol. 12, No. 5. May, 1940. p. 281
Description of high school, civic auditorium and gymnasium building at Everett, Wash.; heating and air conditioning system for auditorium; air washer; fans; heating coils; temperature control for auditorium; air distribution; unit heaters in gymnasium; panel warming for one story section; hot water storage tank in boiler room; water temperature control by thermostatic mixing valve; capacity of storage tank; water for panel system heated in converter; four thermostatically controlled zones; 11,000 ft of steel pipe used for coils; coils embedded in concrete ceiling slabs in some rooms and wired to pipe battens hung from roof slabs in others; flow and return mains; system to be used for cooling with city water; first floor plan showing arrangement of coils.

Piping Changes Increase Efficiency, by William S. Downs
Vol. 12, No. 10. October, 1940. p. 591
Heating of radiators in remote sections of large buildings frequently difficult due to obstructed steam flow; causes of poor flow; condensate piping in office building revised to improve pump operation and steam distribution; effective area of run-outs reduced by inturned burrs from wheel cutters; reaming pipe ends.

Radiant Heating and Cooling, by F. E. Giesecke
Vol. 12, No. 6. June, 1940. p. 357
Explanation of fundamentals of radiant heating and cooling; heat is kinetic energy of molecules; laws governing radiant energy; amount of heat radiated from a surface; formula; radiation factors for common materials; advantages of panel warming or radiant heating; fundamentals of design; calculation of mean radiant temperature; convection currents; film coefficient; heat furnished to room by convection.

Radiant Heating and Cooling, by F. E. Giesecke
Vol. 12, No. 7. July, 1940. p. 421
How surfaces in room radiate heat; total radiation from plane surface; effect of temperature of surface on amount of energy radiated; no fundamental difference between ordinary radiator heating and radiant heating; how mean radiant temperature affects comfort; determining required radiant and air temperatures; graphs showing heat loss or gain by convection for various air temperatures in Btu per hr per person, heat loss or gain by radiation for various mean radiant temperatures in Btu per hr per person, and relationship between air temperature and mean radiant temperature for various combined convection and radiation heat losses; use of charts; figuring building heating load; heat dissipation from heating coils in concrete slab; results of laboratory test; methods of installing heating coils in United States and Europe.

Radiant Heating and Cooling, by F. E. Giesecke
Vol. 12, No. 8. August, 1940. p. 484
Curves showing heat delivered by radiation to a room by pipe coil panel for various heating panel and mean radiant temperatures; curves showing heat transmission from panel to air by convection and conduction; basis and use of the curves; calculating the panel size; figuring pipe coil size; method of constructing pipe coils; spacing; required water temperature.

Radiant Heating and Cooling, by F. E. Giesecke
Vol. 12, No. 9. September, 1940. p. 527
How to design a floor coil heating panel; flow of heat into and through soil; temperatures at various depths; two types of floor construction analyzed; method of calculation; calculating capacity of pump for forced circulation panel warming system; friction head; loss of head in coil; method of connecting coils; accuracy of calculations.

Radiant Heating and Cooling, by F. E. Giesecke
Vol. 12, No. 10. October, 1940. p. 589
Use of a blanket of warm air for heating a ceiling for radiant or panel warming; analysis of a typical room; method of figuring amount of air to circulate, temperature, etc.; incoming air could be filtered and humidified; typical panel warming installations; department store in Switzerland has coils for heating the building in winter, cooling it in summer, and supplying part of the reinforcement for the concrete slabs; danger of condensation studied; results of summer cooling on a typical day; radiant cooling in a hospital operating room; other installations. (Also see p. 657, November issue.)

School Heating and Ventilating, by Meryl L. Todd
Vol. 12, No. 11. November, 1940. p. 659
Heating and ventilating installation for Longfellow elementary school, Waterloo, Iowa; air distribution system unusual; the duct layout; special acoustically treated air distribution cabinets in the classrooms; the scheme of air circulation; sheet metal work; installing air distribution cabinets; automatic control system; day operation; night operation; electric time clocks; central station control system is electric; booster coil and individual convection heaters pneumatically controlled; convection heaters in corridors, toilets and storage spaces; (automatically operated boiler room for this school described in October HPAC).

Smoke Elimination Committees Present Recommendations to Mayor of St. Louis
Vol. 12, No. 4. April, 1940. p. 234
Review of reports of two committees on elimination of smoke in St. Louis; recommendations of the committees; new ordinance suggested would specify that all plants burning a high volatile fuel must employ mechanical fuel burning equipment.

Space Between Floor Joists Used for Heating
Vol. 12, No. 3. March, 1940. p. 169
Brief description of method of heating used in rebuilding Shawneetown, Ill.; town relocated because of floods; space between precast floor joists for heat distribution.

Steam Pressure for Central Heating, by Samuel R. Lewis
Vol. 12, No. 11. November, 1940. p. 122-(back section)
HPAC reader asks for information on economical pressure range for a heating plant for a group of buildings; changing over central heating plants from high to low pressure operation; reduced heat loss with lower steam temperatures; superheat and condensation; the boiler; pipe size; allow for future growth; central plant heating with hot water; European installations used two hot water supply mains for flexibility.

Study Uses of Solar Heat
Vol. 12, No. 3. March, 1940. p. 179
Experimental house constructed at Massachusetts Institute of Technology, Cambridge, Mass., for research on utilization of solar radiation for heating and air conditioning.

Sun Heats Water for USHA Project
Vol. 12, No. 10. October, 1940. p. 590
Public housing project in Miami, Fla., uses solar water heaters.

Tremendous Field for Improvement in Existing Plant Heating Systems, by Samuel R. Lewis
Vol. 12, No. 1. January, 1940. p. 16
Examples showing the tremendous field for improvement in operation and maintenance of existing heating systems; water tubes in boiler clog; no stop check valves; steam header poorly supported; return piping in poor condition; how plant was corrected; lack of insulation in apartment building; how various boiler installations were changed to improve operation; use of zoned hot water heating systems; rating of convectors; explanatory sketches.

Unit Heater Over Revolving Door Solves Entrance Heating Problem, by John G. Endie
Vol. 12, No. 5. May, 1940. p. 307
Method of installing unit heater over revolving door to heat cold air brought in by door; diagram.

Unit Heaters Prevent Cold Drafts at Building and Store Entrances, by D. R. Rippey
Vol. 12, No. 4. April, 1940. p. 249
Eliminating drafty conditions near entrances a difficult problem for the operating engineer or building manager; one of the hardest types of occupancies is the restaurant; how a unit heater was installed in a restaurant to prevent cold drafts; methods of using unit heater for heating building lobbies; the problem of the small retail store; unit heaters installed in lobbies of May department store, Cleveland, Ohio.

Units Using Diesel Cooling Water Heat Plant, by Francis A. Westbrook
Vol. 12, No. 11. November, 1940. p. 664
Diesel engines for generating power installed at Rockford Screw Products Co., Rockford, Ill.; engine cooling water used in six unit heaters for heating the building; thermostatically controlled louvers provide for discharging heated air outdoors in summer.

Vertical Conversion Gas Burners, by L. S. Reagan
Vol. 12, No. 6. June, 1940. p. 362
Development of gas burners composed of multiplicity of burner heads that discharge heat upwardly in the firebox; design of burners; accessory equipment; importance of approval of gas company; what the specifications should include; controls for gas burners—full on and full off, and floating or modulating; draft regulators should be used; simple rule for sizing draft regulator; sketches showing burner installations in various types of boilers; diagrams of various types of control.

Wall Warming System Complements Air Conditioning of New Building
Vol. 12, No. 7. July, 1940. p. 405
Description of air conditioning and heating of Bankers Life Co. home office building, Des Moines, Ia.; wall warming scheme utilized; not to be confused with radiant heating; wall warming system adds 8 per cent to total useful floor area; wall construction; cork insulation; double glass windows; glass brick; air conditioning integral part of building design; air distribution; zoning the system; refrigeration plant; capacity control; complete control panel in machine room with similar board in building superintendent's office; meters and controls; electrostatic air cleaning apparatus; oil burning boilers; smoke alarm; combustion recorders.

Warm Air for Plant, Hot Water for Offices
Vol. 12, No. 8. August, 1940. p. 480
New plant of the Aviation Mfg. Corp., Nashville, Tenn.; the problem encountered by the architects and engineers; factory heated by circulating air system; filtered air supplied the year around; location of the heaters; heat resisting glass used; air conditioning system for administration building; condenser water cooled by being sprayed on underground water reservoir roof; administration building heated by forced circulation hot water radiation and forced air; stoker fired boiler; hot water mains run overhead in factory to basement of office building.

Water Treatment for Heating Boilers, by Kalman Steiner and Ralph A. Nelson
Vol. 12, No. 3. March, 1940. p. 177
Explanation of why boiler water treatment is necessary; simplified review of chemistry involved; how water is contaminated; types of chemical substances; the meaning of the term "concentration"; impurities in water; effect of hard

water; corrosion and electrolysis; caustic embrittlement; map showing average hardness, by states, of water furnished in 1932 by public supply systems.

Water Treatment for Heating Boilers, by Kalman Steiner and Ralph A. Nelson
Vol. 12, *No.* 7. *July*, 1940. *p.* 428
Internal and external treatment of boiler feedwater; definition of solubility; temporary and permanent hardness; causes of scale; soda ash treatment; other boiler compounds; corrosion and caustic embrittlement; open feedwater heater; zeolite softener; lime-soda softener; other methods of control; significance of carbonate-sulphate ratio; specimens of feed lines and boiler tubes showing scale.

Piping

ASTM Committee Reports New Specifications
Vol. 12, *No.* 10. *October*, 1940. *p.* 602
Several papers and reports on ferrous materials presented at 1940 annual meeting of American Society for Testing Materials; steel plate specifications; hardness testing; new grade of high strength boiler rivet; committee on alloys reports progress; need for and importance of standards and specifications.

Avoiding Plant Shutdowns, by W. H. Wilson
Vol. 12, *No.* 10. *October*, 1940. *p.* 598
("Open for Discussion"); industrial plants engaged in manufacture of defense and war material must be prepared for continuous operation; importance of a well kept up stock of supplies, tools and spare repair parts; welding equipment; gaskets; tools; specialties; lubricants; listing important repair and maintenance jobs; value of trained operating personnel; emergency repair for a leaking water storage tank; chain hoists prevent vibration of steam line in emergency.

AWS Committee Compiles Definitions of Welding Terms
Vol. 12, *No.* 8. *August*, 1940. *p.* 472
Excerpts from a compilation of definitions of welding terms prepared by a committee of the American Welding Society.

Circulating Piping Systems Promote Efficiency in Industrial Finishing, by L. J. McGrady
Vol. 12, *No.* 11. *November*, 1940. *p.* 665
Automotive and other plants now using paint circulating systems, the paint being mixed in a central room and conveyed to the various stations by pipe line; advantages of method; description of how system operates; piping layout; valves and regulators; kind of pipe used; finishing material circulated at night at reduced pressure.

Complete Control of Piping Systems Eliminates Errors at Campana Plant, by R. D. Frick
Vol. 12, *No.* 2. *February*, 1940. *p.* 103
Description of production process and piping systems at plant of Campana Corp., Batavia, Ill., for manufacture of "Italian Balm" and "Dreskin"; specifications for handling ingredients very exact; automatic control essential; accurate weighing of ingredients depends upon piping layout; use of photo-electric "eyes"; remote control panel board; double orifice valves used; tanks are on turn-tables; organization of maintenance department; air conditioning and heating the plant; well water for cooling; photographs illustrating production process.

Dam Is Refrigerated, by Walter E. Becker
Vol. 12, *No.* 5. *May*, 1940. *p.* 284
Generation of heat by wet concrete; ammonia refrigeration system to cool water for circulation through new Marshall Ford dam, Rutledge, Tex.; capacity.

Design of the Piping Service Tunnel at Chronic Disease Hospital Described, by Robert Grahn with T. S. Tenney
Vol. 12, *No.* 3. *March*, 1940. *p.* 168
Description of underground piping tunnel at hospital for chronic diseases on Welfare Island, New York, N. Y.; drawing showing pipe details; description of piping arrangement; air intake windows; heating done with hot water and steam unit heaters; exhaust steam from turbines driving hot water circulating pumps used.

Diagram Board at Lansing Station Shows the Piping and Valve Layout, by R. C. Roe
Vol. 12, *No.* 2. *February*, 1940. *p.* 102
Brief description of combustion control for Ottawa St. Station, Lansing, Mich.; combined electric generating and district heating plant; pre-measuring principle used; the diagrammatic control board; architectural treatment of exterior symbolizes combustion of coal.

Do Piping Improvements Pay?, by A. C. Kirkwood
Vol. 12, *No.* 10. *October*, 1940. *p.* 581
Analyzing suggested plant piping improvement from the financial standpoint; coördinating the several factors of cost; writing off capital expenditures; amortization; sinking fund; chart for determining amortization in per cent of investment; second chart for determining savings and percentage of profit on an investment in piping modernization.

Electric Heat Maintains Free Flow of Asphalt, by J. Schneider
Vol. 12, *No.* 7. *July*, 1940. *p.* 436
Electric heating units wound spirally around 600 ft of unloading pipe line at Byerlite Corp. plant, Cleveland, Ohio; advantages of using electric heat; unloading time and unloading costs reduced; output tripled.

Flow Meter Accuracy Governed by the Pipe Layout, Pressure Tap Location, by L. K. Spink
Vol. 12, *No.* 3. *March*, 1940. *p.* 155
Supplementary information on how piping design and layout affects flow meter accuracy published in answer to reader's comment on article by L. K. Spink in November, 1939, HPAC; variation of static pressure in neighborhood of an orifice; diameter of pressure taps; proper axis for pressure taps; data from American Gas Association committee report on meter runs; length of pipe preceding and following an orifice for different orifice to pipe diameter ratios and different piping layouts; graphs and sketches of installations.

How to Figure the Cost of a Process Piping Shutdown, by A. C. Kirkwood
Vol. 12, *No.* 2. *February*, 1940. *p.* 87
Method of figuring amount of money it is economical to spend to sectionalize process steam headers; cost of a shutdown based on annual value of product; losses for various outages; typical example showing steam piping layout for six kettles and the way it might be sectionalized; savings made possible by improving piping layout for different annual product values; items other than dollar values to consider.

Insulation of Piping, by E. T. Cope and W. F. Kinney
Vol. 12, *No.* 9. *September*, 1940. *p.* 524
Insulation problems and practices discussed in paper presented before semi-annual meeting of ASME; insulating large high temperature piping; assembly of sectional insulation; method of installation; effect of joints in insulation on uniformity of heat loss; covering large bends; insulating underground steam piping; insulating piping for fluids below 50 F; method of sealing insulation on low temperature piping.

Keep the Piping Clean, by Otis E. Russell (with Francis A. Westbrook)
Vol. 12, *No.* 7. *July*, 1940. *p.* 434
Use of brass piping for transportation of materials in process at Lydia E. Pinkham Medicine Co., Lynn, Mass.; manufacturing process; copper tubing; how piping is cleaned; regular schedule for cleaning; union couplings avoid pockets in filling line.

New Technique Developed for Insulating Cold Fluid Piping, by E. T. Cope and W. F. Kinney
Vol. 12, *No.* 12. *December*, 1940. *p.* 703
Failure of commonly used type of vapor barrier on insulated chilled water piping for an air conditioning system; new technique desired; rigid space limitations; no room for piping maintenance or repairs; emulsified latex as waterproofing film; accelerated aging tests by oxygen bomb method; effect of painting; results of tests; design of pipe supports; assembly and erection; use of chain falls and screw jacks; detailed description and illustrations of how insulation and vapor barrier was applied; sealing butt ends; cost of the method; results after a season's experience; need of new methods.

Oxy-Acetylene Welding Procedure for High Pressure and Temperature Piping
Vol. 12, *No.* 5. *May*, 1940. *p.* 308
Review of papers on oxy-acetylene welding for high pressure and temperature piping presented at annual convention of International Acetylene Association; conclusions of paper describing laboratory development of procedure; preheating, concurrent heating and postheating; field testing and application; time required for making welds and for stress relief; specification for oxy-acetylene fusion welding of carbon-molybdenum steel pressure pipe lines; size of welding tip to use; method of "short time stress relief."

Piping Flow Problems Made Easy, by William Goodman
Vol. 12, *No.* 10. *October*, 1940. *p.* 603
Criterion for turbulent flow; Reynolds' number; description of chart for simplifying piping flow problems; examples; finding pressure drop; rate of flow through pipe line; basis of the chart.

Piping Problems Are Considered at Annual Meeting of the ASME
Vol. 12, *No.* 1. *January*, 1940. *p.* 31
Brief review of three papers on piping presented at annual meeting of American Society of Mechanical Engineers; significance of the suggested limits for stress in pipe lines due to combined effects of pressure and expansion; stress intensification factors; allowable ranges for combined pressure and expansion stresses; three dimensional pipe bends; heat transfer to water films; heating water flowing in vertical copper pipes; formula.

Possible Savings with Welded Construction
Vol. 12, *No.* 3. *March*, 1940. *p.* 154
Brief review of three papers submitted in award program of James F. Lincoln Arc Welding Foundation; improved design of refrigerant control piping for fabrication by arc welding; welded valve bodies; air conditioning plant.

Power Piping Drafting Today Requires Skill and Knowledge, by Albert Jorgensen
Vol. 12, *No.* 4. *April*, 1940. *p.* 225
Recent advances in power piping design and installation make imperative a greater degree of control through drawings and specifications; functions of the piping draftsman; sources of piping information; explanation of procedure in piping design; types of drawings used; scales; examples of drawings.

Practical Piping Problems—Making Branch Connection to Pipe Line Under Pressure, by W. H. Wilson
Vol. 12, *No.* 3. *March*, 1940. *p.* 167
Pipe saddles and pipe clamps of use in maintenance work for making connection to pipe line under pressure; diagram and description of method.

Practical Piping Problems—Piping Leaks, by W. H. Wilson
Vol. 12, *No.* 2. *February*, 1940. *p.* 116
Importance of watching out for piping leaks that are not easily visible; an apparent leak in a fuel oil line in a large plant that caused trouble; difficulty traced to relief valve improperly adjusted which was discharging into pump suction.

Practical Piping Problems—Thirty Years' Experience with a Steam Main, by W. H. Wilson
Vol. 12, *No.* 6. *June*, 1940. *p.* 348
History of and reminiscences about an industrial plant steam line which has been in service over 30 years; description of

the piping; trapping; troubles that have come up and how they have been solved; changes that would be considered if this steam supply line were to be renewed or a similar one installed today.

Proposed American Standard for Butt Welding Fittings Submitted, by Sabin Crocker
Vol. 12, *No.* 1. *January*, 1940. *p.* 11
General discussion of problems involved in standardizing products such as welding fittings; conflicting dimensions; scope of the standard; materials specification; acceptance by industry; the standard itself, with tables of dimensions for butt welding elbows and tees, caps and lapped-joint stub ends, reducers and return bends; dimensions of welded and seamless steel pipe.

Reinforcing Welded Branch Connections, by F. C. Fantz and W. G. Hooper
Vol. 12, *No.* 4. *April*, 1940. *p.* 247
Abstract of paper presented at annual meeting of American Welding Society; definite rules and formulas pertaining to welded branch connections for piping are lacking; requirements of ASME code for unfired pressure vessels; rule developed for applying branch connections in pipe sizes from 1 to 24 in.; summary of the formula and how it is used; data on plain nozzle welds, saddle reinforcement and ring reinforcement; ring and saddle dimensions.

Standard Bypasses for Main Line Control Valves, by John J. Harman
Vol. 12, *No.* 1. *January*, 1940. *p.* 23
Necessity of using bypasses around valves; standard bypass sizes established by Manufacturers Standardization Society of the Valve and Fittings Industry; tables showing bypass sizes for various valve sizes; sketch of bypass for a gate valve.

Standardization of Pipe Welding Bevels
Vol. 12, *No.* 2. *February*, 1940. *p.* 94
Comment by Sabin Crocker on article by M. R. Scott on welding heavy wall pipe published in October, 1939, HPAC; recommended practice of American Standards Association for welding bevel; reason for standardizing; reply by M. R. Scott; sketches showing standard U bevel and standard straight bevel for welding ends.

Stored Steam Increases Plant Capacity
Vol. 12, *No.* 11. *November*, 1940. *p.* 668
Use of steam accumulators for increasing plant capacity to meet new conditions; heat storage acts as a "thermal flywheel"; installation at coal mine where fluctuations are produced by engines operating hoists; advantages of steam accumulator installation; size and capacity.

Supporting Horizontal Tanks, by Max M. Salzman
Vol. 12, *No.* 12. *December*, 1940. *p.* 719
Answer to a reader's question on supporting horizontal tanks; tables and drawings showing spacing of concrete saddles for various lengths of tanks; checking the stresses in such a design; equations; sample calculation.

Thickness of Steel for Tanks
Vol. 12, *No.* 4. *April*, 1940. *p.* 238
Formula for figuring thickness of steel for vertical storage tanks; how to change constant for liquids of various specific gravities.

Types of Drawings Used in Power Piping Drafting, by Albert Jorgensen
Vol. 12, *No.* 5. *May*, 1940. *p.* 285
Piping assembly drawings; scales used; examples of such drawings; explanation of examples; details of pipe supports; example; model of power plant piping.

Types of Drawings Used in Power Piping Drafting, by Albert Jorgensen
Vol. 12, *No.* 6. *June*, 1940. *p.* 351
Shop drawings; scales used; marking pieces; other power piping drawings; specifications; use of models; examples of fabrication layout sketch with corresponding design drawing, shop drawings and photograph of a model of power plant piping.

Use of the Ring Joint on Oil and Steam Piping Service, The, by F. R. Venton and A. W. Marburg
Vol. 12, *No.* 7. *July*, 1940. *p.* 425
Origin of ring joint; mechanical analysis of joint; comparison of ring joints with flat gasket joints; equations; forces acting on octagonal ring assembled in joint; bolt load; effect of flange separation; advantages of octagonal ring as compared with oval ring; differences between oil and steam service conditions; why trouble has occurred on high pressure, high temperature steam installations; table reporting hydrostatic tests on 12 in., 1350 lb flange joints; causes of leakage.

Use of the Ring Joint on Oil and Steam Piping Service, The, by F. R. Venton and A. W. Marburg
Vol. 12, *No.* 8. *August*, 1940. *p.* 489
Investigation of characteristics of ring joint undertaken; assembly for temperature tests; formula for elongation of bolts; two series of quench tests; use of water for quenching; curves showing temperature of flanges, bolts and ring for the various tests on different types of joints.

Use of the Ring Joint on Oil and Steam Piping Service, The, by F. R. Venton and A. W. Marburg
Vol. 12, *No.* 9. *September*, 1940. *p.* 548
Summary of conclusions based on investigation of the characteristics of the ring joint, with special emphasis on its ability to withstand temperature fluctuations; hub contraction of welding neck flanges; blind flanges; bolt load loss.

Water Consumption in Hotels
Vol. 12, *No.* 11. *November*, 1940. *p.* 667
Review of booklet by Georges C. St. Laurent and published by American Hotel Association; cost of water to hotels on the increase; re-using condenser cooling water; use of evaporative condensers and cooling towers; use of well water; how water consumption of boiler room and engineering departments may be reduced.

Welded Piping Got Attention
Vol. 12, *No.* 11. *November*, 1940. *p.* 650
Summaries of papers on piping presented at annual meeting of American Welding Society; fillet welds in piping; studies made; results of investigation; welding carbon-moly piping for high temperature, high pressure service; joint designs for pressure piping; advantages and disadvantages of various joints; welding copper and brass; preheating and normalizing; investigation on welding thin and thick wall tubing for naval service.

Will a Wood Joist Near a Steam Pipe Catch Fire?
Vol. 12, *No.* 4. *April*, 1940. *p.* 230
(Answer to a reader's question prepared by John A. Neale); temperature at which wood will ignite depends on a number of things; requirements of building code for clearance where steam or hot water heating pipes pass through floors or partitions.

Will These Piping Changes Pay?, by A. C. Kirkwood
Vol. 12, *No.* 7. *July*, 1940. *p.* 410
Three departmental requests for process piping changes and sectionalizing valves analyzed; how to figure whether changes will pay; value of product affects answer; conclusions.

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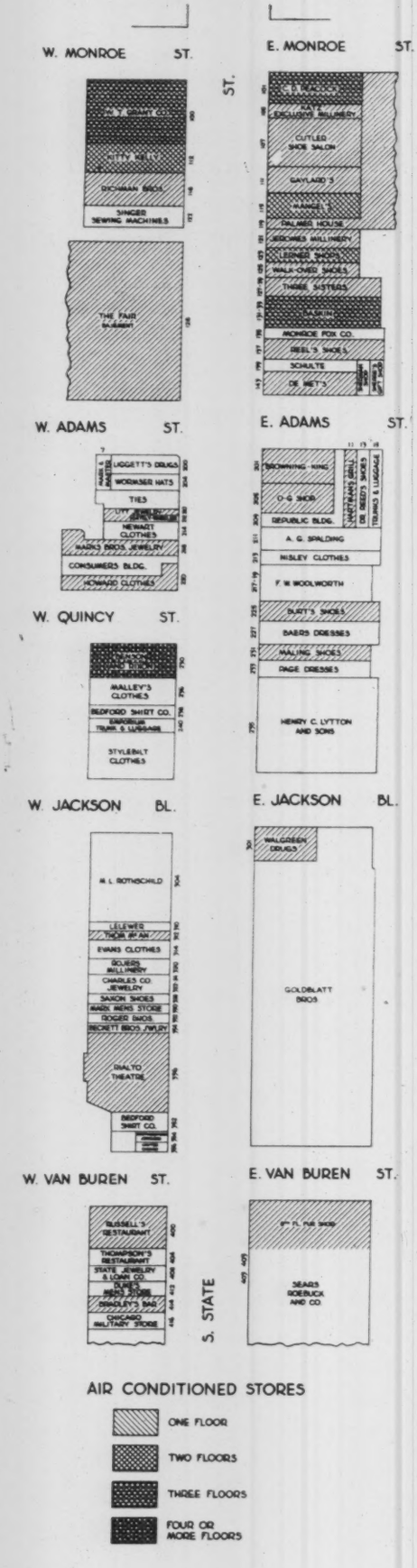
SOLD ON AIR CONDITIONING



State Street Chicago

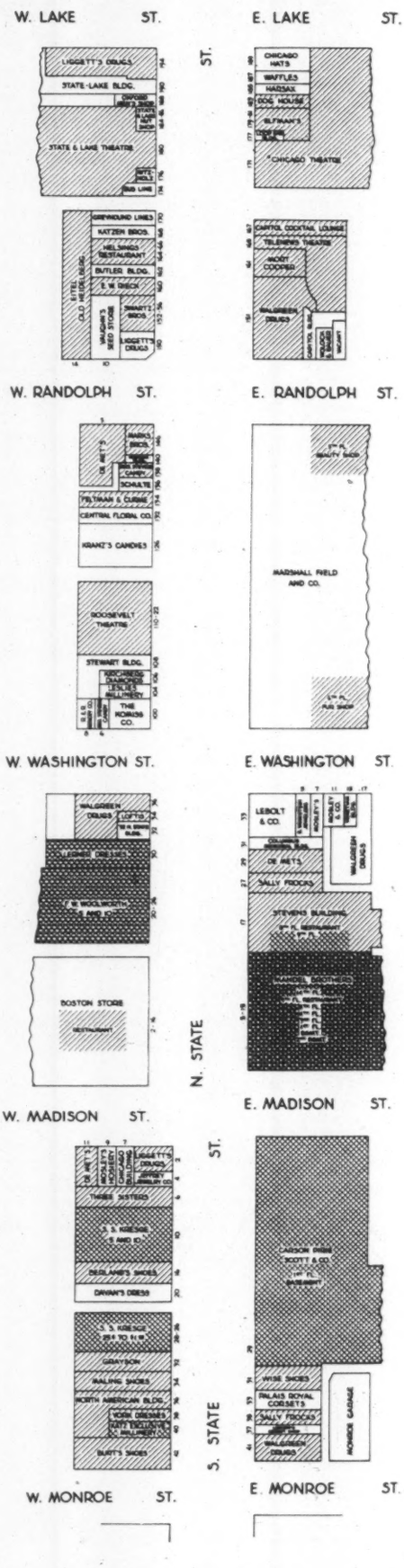
State Street, Chicago, is one of the world's great shopping centers. Along the length of its slightly sunken surface—they're digging a subway underneath it—are ranged the famous department stores—Field's, Carson's, Mandel's, the Fair, the Boston Store and others. Sears, W. T. Grant, Woolworth, Kresge, Walgreen, Liggett, Baskin, Benson & Rixon, Browning-King—and many more — are represented on State. There is the Palmer House and movie theaters like the State-Lake, Chicago and Roosevelt; and burlesque is represented by the Rialto.

The air conditioning division of Commonwealth Edison Co., the electric utility serving Chicago, has prepared the accompanying map of that portion of State Street which is within the Loop, starting north from Van Buren at the bottom left and ending at Lake Street at the top right. Air conditioned establishments are cross-hatched according to the number of floors which are air conditioned as shown by the key at the lower left.

Apparently, State Street is "sold" on air conditioning—though not as yet unanimously.

Similar maps of outlying shopping centers in the city have also been prepared by the air conditioning division and issued to the industry. The one for the 63rd and Halsted district appeared in our March, 1938, issue.

[Note—Space shown as occupied by Jerome's Millinery and Lerner shops is now occupied by Broadstreet's, which has two air conditioned floors.]



This map, prepared by the air conditioning division of Commonwealth Edison Co., shows the air conditioned establishments along that part of State Street which is within the Loop, Chicago's downtown area. Air conditioned buildings are cross-hatched, the heavier the shading the greater the number of floors which are conditioned

TRY TUBE-TURNS

with Tube-Turn SLIP-ON FLANGES!

The word "Tube-Turn" is NOT a necessary general trade name for welding fittings. It is the registered trade-mark for the products made by Tube-Turns, Incorporated, under their patents.

● For good piping construction and lowest cost, use Tube-Turns with Tube-Turn Slip-On Flanges whenever flanged joints are required. You'll find that long radius, 1½R Tube-Turns work better with Slip-On Flanges than any other welding elbows because:

First: Tube-Turns, having uniform walls throughout with no excess thickening at the crotch, thus maintain an outside diameter that is extremely close to nominal. *Second:* Tube-Turns are made to such close tolerances that they always slip easily into the bore of slip-on flanges a sufficient depth to meet recommended practice and permit making a sound, strong joint.★

This is just one reason why, for completely dependable piping, it pays always to specify Tube-Turn Fittings and Flanges. The Tube-Turn line includes 90° and 45° Elbows, 180° Returns, Tees, Reducers, Caps, Lap-Joint and Shaped Nipples, Crosses, Laterals, Saddles, and all sizes, weights and types of Forged Steel Flanges. . . . Get all the facts, and a lot of valuable engineering data as well, from our new Catalog and Data Book No. 109. Ask your Tube-Turn Distributor for a copy, or write us direct. TUBE-TURNS, Incorporated, Louisville, Kentucky.

★ In sizes below 4" it is impossible to use slip-on flanges on both ends of any stock fittings (Tube-Turns or others) because the flanges project too far to clear each other.

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When you use Detroit No. 450 Refrigeration Controls, you are getting the utmost in dependability and a degree of flexibility not to be found in other controls. Strong, sturdy parts that are readily interchangeable—right on the job or in your shop. All this can be done without affecting the pressure or temperature setting.

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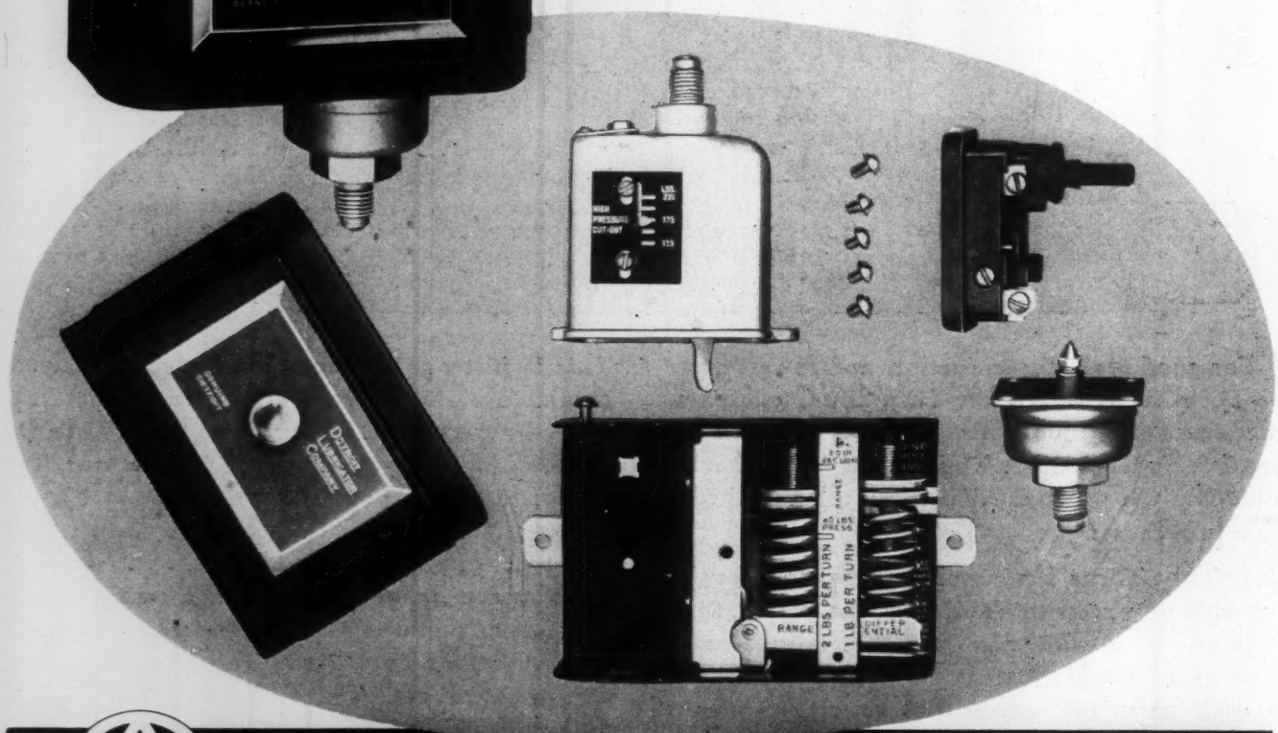
Detroit Controls are available in a complete range of models for every type of application. Start taking advantage of these features.

Why not see your wholesaler about Detroit Controls right away.



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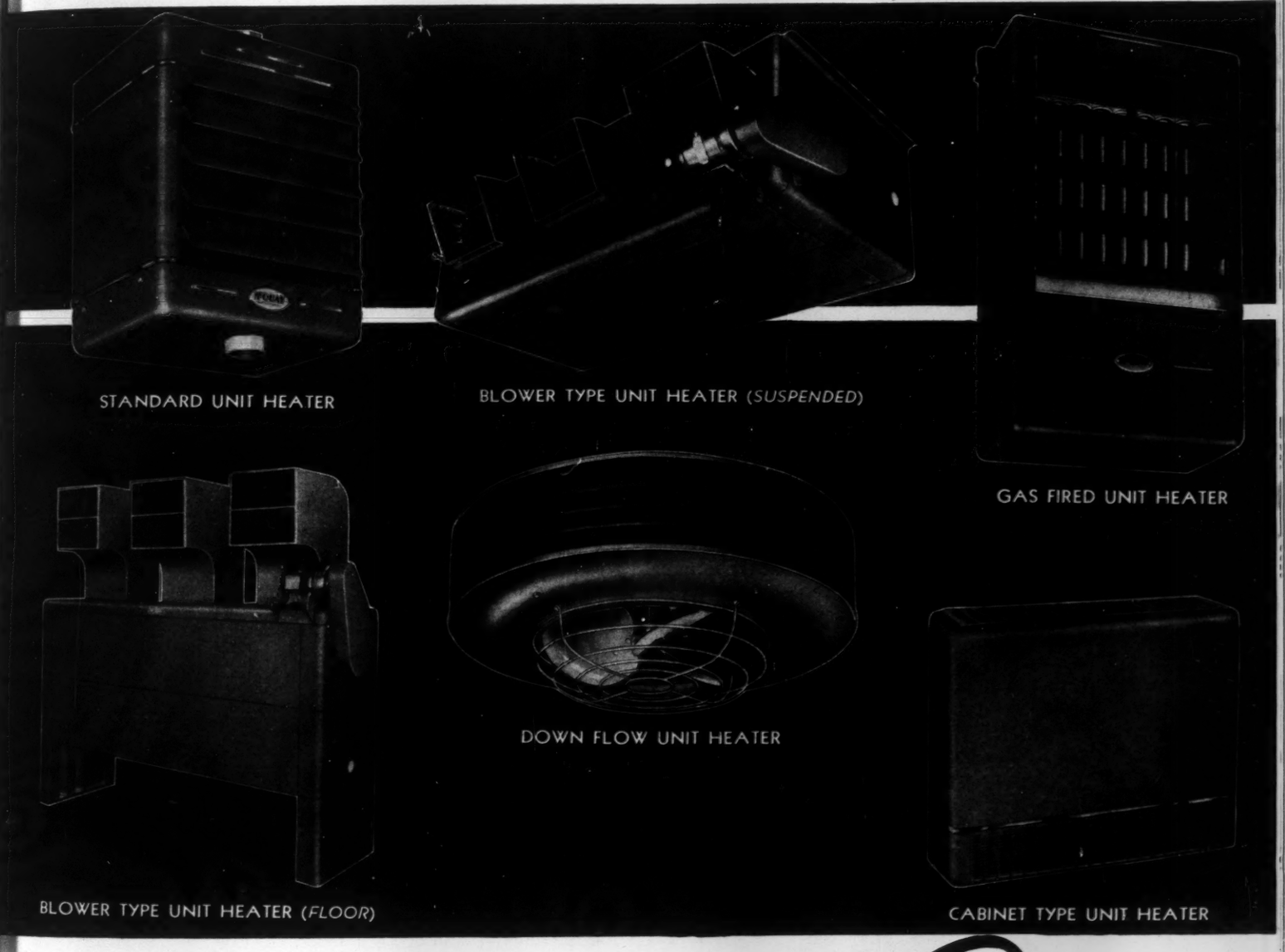
THE *New Light* IN AN ALL STAR LINE



STANDARD UNIT HEATER

BLOWER TYPE UNIT HEATER (*SUSPENDED*)

GAS FIRED UNIT HEATER

DOWN FLOW UNIT HEATER

BLOWER TYPE UNIT HEATER (*FLOOR*)

CABINET TYPE UNIT HEATER

THE McQuay Radial Type Unit Heater is the newest and the brightest light in this all star line. It is exclusive with McQuay. The McQuay line is complete and gives you a unit heater for every possible application. The new Radial Type Unit Heater provides wide, uniform heat distribution, lower installed cost and new economy of operation. One Radial Heater can be used in place of two or more standard units. You need look no farther than McQuay for your unit heater needs. McQuay, Inc., 1601 Broadway St., Minneapolis, Minn.

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McQuay INC.

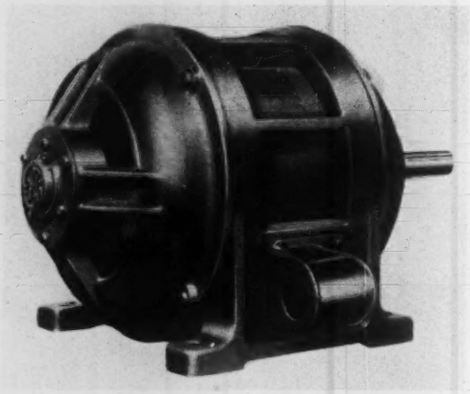
Air Conditioners . . . Air Conditioning Coils . . . Blast Coils . . . Blower Coolers . . . Comfort Coolers . . . Cabinet Radiation . . . Concealed Radiation . . . Evaporative Condensers . . . Indoor Cooling Towers . . . Ice Cube Makers . . . Icy-Flo Accumulators . . . Refrigerating Coils . . . Room Coolers . . . Unit Heaters . . . Unit Coolers . . . Water Cooling Units

Equipment DEVELOPMENTS

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January, 1940, HEATING, PIPING AND AIR CONDITIONING and thus keep your records of sources of supply up to date throughout the year . . . Single asterisk (*) indicates equipment not listed in Directory Section; double asterisk (**) equipment and manufacturer not listed

Triple Voltage Motor for Compressors

No. 2005—By means of a special arrangement of stator windings, a new three phase motor can be readily reconnected at the terminal board for compressor drive service on any one of three voltages, the manufacturer



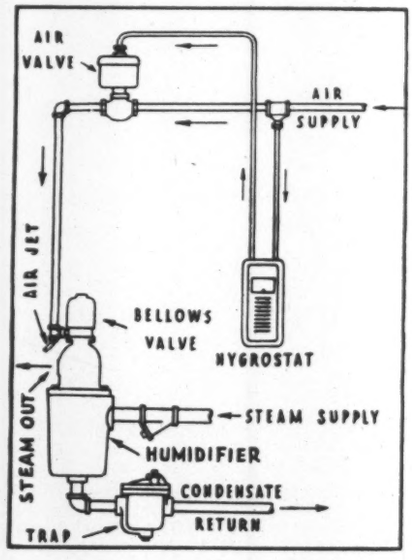
announces. Because the motor is designed particularly for application in the air conditioning and commercial refrigeration fields, it is ordinarily supplied for 199, 208 and 220 volt operation.

The motor will provide three different torques, depending upon how its leads are connected at the terminal board for a given line voltage. This feature makes it suitable for use in applications which permit an adjustment between torque and current values for a given line voltage. Therefore, the advantages it offers include proper torque to meet requirements of individual applications; operation on the voltage available at the compressor, whether it be 199, 208 or 220 volts; more flexibility in making installations; and a material decrease in the number of stock motors necessary for different applications in the refrigeration and air conditioning fields, says the maker.

Regardless of the voltage employed, all of the stator winding is used all of the time and thus the motor characteristics are maintained under all operating circumstances. The new motor incorporates the "Valv-Amp" rotor recently announced by the same company and is available in sizes through 200 hp.—General Electric Co., 1 River Rd., Schenectady, N. Y.

Air Operated Humidifier

No. 2006—A new air operated steam type humidifier for installation in locations where electric circuits would be undesirable is believed to have a considerable field of use in chemical or processing plants using inflammable solvents, in munition plants handling gun powder, in milling plants having dust explosion hazards and in hospitals using explosive anesthetics.



As shown by the accompanying diagram the assembly includes a pneumatic hygrostat which acts as a pilot valve to admit pressure to the diaphragm chamber of the main air valve when the relative humidity drops below the desired percentage. Opening of the main air valve allows compressed air to flow to the humidifier when the pressure builds up and opens a steam valve in the top of the humidifier. The steam valve admits steam to a special silencing chamber in the humidifier from whence it escapes directly to the atmosphere to add humidity to the room. Circulation and distribution of the steam is facilitated by allowing a small amount of compressed air to blow through a nozzle directly above the steam outlet.

To insure dryness of the steam released by the humidifier, the entire silencing chamber is jacketed with

FOR YOUR CONVENIENCE

HEATING, PIPING AND AIR CONDITIONING, [12-40]
6 N. Michigan Ave., Chicago, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in "Equipment Developments" and "Recent Trade Literature." (Circle each number in which you are interested):

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
2015	2016	2017	2018	2019					
3712	3713	3714	3715	3716	3717	3718	3719	3720	3721
3722	3723	3724	3725	3726	3727	3728	3729	3730	3731
3732	3733	3734	3735	3736					

Name ..... Title .....

Company .....

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City ..... State .....

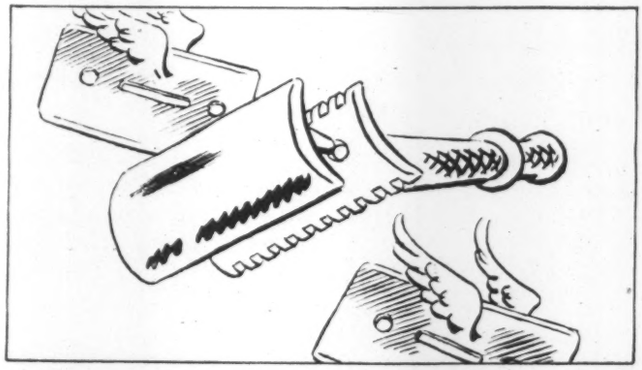
Guide to a Merry Xmas for plant engineers

1 Install Dust-Stop* Air Filters and you'll be a real Santa Claus to every worker in your plant. Dust-Stops cost approximately 1-cent per CFM to install, including frames; approximately 1/10th-cent per CFM, when filters need changing.

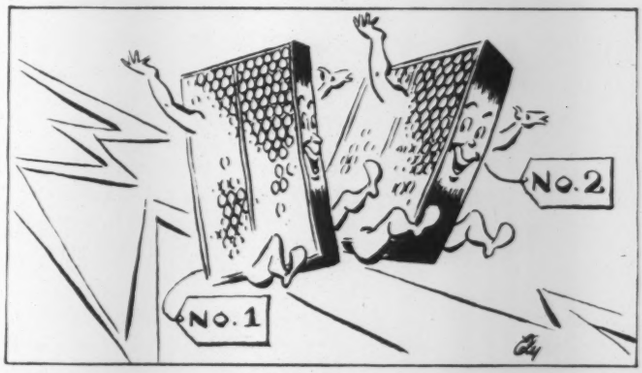
2 And you'll never have this dream about filter fires with Dust-Stops. Don't forget—Dust-Stops are safer, because the all-glass filtering medium, Fiberglas* fibers, and the patented adhesive will not support combustion.

3 And brother, the interference Dust-Stops put up against dirt passage is wonderful! Capacity: 2 CFM per square inch of area at 300 FPM. Resistance: (in inches of water gauge per inch of depth) .045 to .050 clean, and .11 to .12 dirty. They stop virtually all "nuisance" dusts.

4 Nobody can put you behind the "8" ball, because of bleeding. For Dust-Stops don't bleed. The filtering adhesive will not deposit tiny droplets in the ducts or on the walls. And of course they also eliminate the fire hazard from oil in the duct system.



5 Changing Dust-Stops is as easy as changing a razor blade. No skilled labor required. This replaceable filter fits all types of air handling systems. It eliminates recharging, draining, expert supervision, and the need to keep a supply of spares.



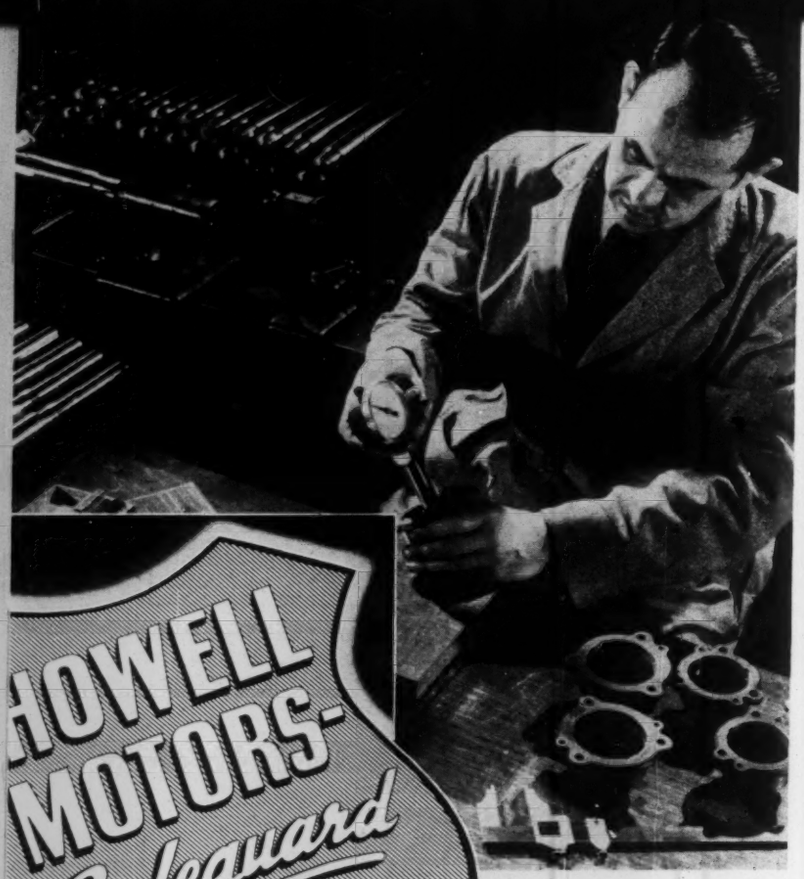
6 So give yourself a Merry Xmas and an Economical New Year by installing replaceable Dust-Stops. Your supply of No. 1 (1-inch) and No. 2 (2-inch) will come promptly from your air conditioning manufacturer, jobber or dealer. Or write: Owens-Corning Fiberglas Corporation, Toledo, Ohio.

FIBERGLAS* DUSTOP* AIR FILTERS

*T. M. REG. U. S. PAT. OFF.

Made by Owens-Corning Fiberglas Corporation, Toledo, Ohio

DIRECT CANADIAN INQUIRIES TO FIBERGLAS CANADA, LIMITED, OSHAWA, ONTARIO



HOWELL MOTORS—Safeguard Your Conditioning Installations

EXAMPLES OF PRECISION

One in a Series of Advertisements, "HOWELL Motors in the Making"—showing how modern precision standards maintain HOWELL quality. . . .

VERY PART Must Be Within .0003 Inches

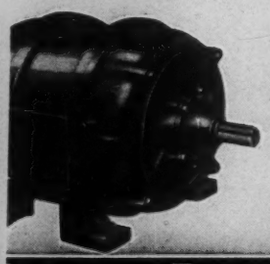
o Get This Man's O.K.

Accuracy is almost a fetish at HOWELL! All parts of a HOWELL Motor are manufactured to the closest practical limits — with EXACTING TESTS made "all down the line" to be sure that every part measures up.

Photograph above shows how shafts and bearing housings are checked for accuracy of dimensions. Johannsen Gauge Blocks are used for setting all inspection gauges, and acceptable tolerances are limited to .0003 inches.

This is typical of the precautions taken at HOWELL to insure QUIETNESS of operation. HOWELL Motors are such a thoroughly precision product that, for all practical purposes, they are VIBRATION-FREE!

COMPLETE LINE — FAST DELIVERY



For 25 years HOWELL has specialized on polyphase motors for air conditioning, ventilating and heating drives. Motors can be furnished with any electrical and mechanical characteristics required — sizes range from ½ to 150 HP, single or multi-speed.

Whatever your drive needs, HOWELL can meet them EXACTLY and on time. Write us, outlining your particular problem!

HOWELL ELECTRIC MOTORS COMPANY

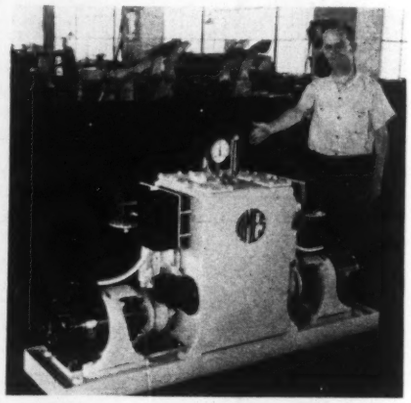
HOWELL, MICHIGAN

Representatives in All Principal Cities

steam at pressure several pounds above the atmosphere. Use of a steam trap prevents accumulation of condensate in the steam jacket. Compressed air for the humidifier may be at any pressure from 20 to 100 lb or less. The unit has a maximum capacity for adding moisture to air at the rate of 44 lb per hr, according to the manufacturer, who states that under average conditions this is sufficient for 40,000 cu ft of space.—Armstrong Machine Wks., 874 Maple St., Three Rivers, Mich.

Vacuum Return Units

No. 2007—A line of vacuum return units, gravity return units and pyramid motor pumps has been developed for use with modern types of selective pressure and temperature control vacuum and gravity return line heating systems. According to their manufacturer, this pumping equipment comprises a uniformly designed line which is vibrationless in operation. Other features of the vacuum return units include a low return sealed against air inleakage, air vent sealed against prime water loss and discharge sealed against prime water loss. All operating parts can be inspected without disturbing the inlet or discharge piping.



The pyramid motor pumps are alike in design from the smallest to the largest and are separately available for general service duty in capacities from 10 to 700 gpm for all standard electrical characteristics. These pumps are standard equipment with the vacuum return and gravity return units.—Ames Hydrovac Corp., 290 Scholes St., Brooklyn, N. Y.

Selector Control

No. 2008—A new selector control for maintaining constant temperature and humidification and dehumidification control in process air conditioning has been announced. It is also entirely suitable for automatic year 'round comfort control, the maker states.

This new selector-control unit, when used with a three wire, "floating" type thermostat or humidistat, provides close control of temperature or humidity under widely varying conditions.

Features of the device include a synchronous timing motor to assure accurate timing; control relays for single pole, double throw switching; conveniently located high voltage and low voltage terminals; and a trim, aluminum finish case.—General Electric Co., Air Conditioning and Commercial Refrigeration Dept., 5 Lawrence St., Bloomfield, N. J.

Flexible Duct Connection

No. 2009—A new woven asbestos flexible duct connection, put up in a package which makes it easy to stock and to keep clean and handle on the job, has been announced. One of the important features, according to

FOR UNDERGROUND STEAM SERVICE...

Here is a system of pre-insulated and pre-sealed piping that is efficient, dependable and economical. It is the DURANT INSULATED PIPE system that comes to you in completely finished units, ready for field installation. No tile or tunnels required and nothing extra to buy. Pipe supports are sealed within the units and the Durant System can be laid with a minimum of trenching and field work. The asphalt protection is permanently waterproof, and the insulation will maintain its efficiency and last as long as the pipe itself.

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TYPE "SH" UNIT

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YOUNG HEATING UNITS

Architects, engineers, and contractors . . . each for his own reason . . . have come to associate the name YOUNG with the latest engineering advancements in heating, cooling, and air conditioning. Young's enviable reputation in these fields is not mere happenstance. It's the reward of endless research and development by the industries' most competent engineers.

No matter which type of Young Unit you select for your next heating or cooling job, remember this: You can do so with complete confidence that they will give years of stand-out performance at a surprisingly low operating cost. Each unit is simple and compact in design . . . constructed to give downright satisfaction. All are sold on a guaranteed capacity rating.

Write for latest Young catalog . . . or consult a competent Young engineer in your locality.

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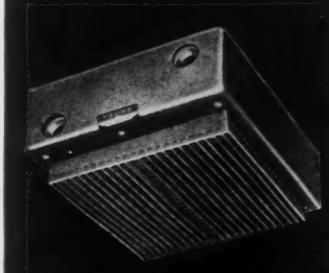


VERTIFLOW UNIT HEATER

F. H. UNIT HEATER

YOUNG RADIATOR COMPANY

RACINE WISCONSIN

Young Quality

the manufacturer, is the selvage edges which are necessary in order to make sure that regardless of the method used for fastening the duct connection to the sheet metal, it will remain permanently and securely in place. The connection is manufactured to comply with the requirements of the fire underwriters.

This duct connection is 6 in. wide and put up in a roll 50 ft long. No special tools are necessary to install it and it can be clamped, bolted or screwed into place.—Grant Wilson, Inc., 4115 W. Taylor St., Chicago, Ill.

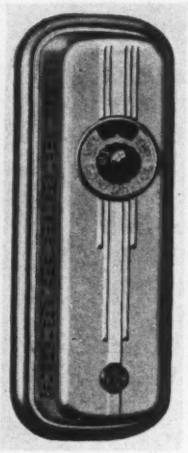
Slide Rule for Duct Design

No. 2010—The "Ductoslide," a slide rule for use by engineers and contractors in designing air distribution systems, was recently patented. It is based on standardized data for rectangular equivalents of circular ducts, and Fanning's formula for the relationship between friction loss, air velocity and diameter.

The rule is designed in such a way that the setting of any two known values makes the rest of the desired data immediately determinable. It is of particular use, according to its inventor, in adding up the total friction of the duct system and in checking of certain values and characteristics at all times whether in the field or office.—Zvi Gezari, 72 Barrow St., New York, N. Y.

Effective Temperature Control

No. 2011—An improved "Comfortrol" for effective temperature control—a humidity compensated thermostat incorporating a multiple human hair element, coupled to a bimetallic temperature element so that the point of dry bulb control is constantly and automatically varied



to suit the existing relative humidity—has recently been announced.

The main improvement of the new model, according to the manufacturer, is the addition on the heating types of anticipation in order to provide close and even effective temperature control. Artificial anticipation is not needed on the cooling type, according to the maker, because of the self-anticipating effect of dehumidifying which occurs with each cycle of the cooling equipment.

This instrument is suitable for use with all types of heating and cooling equipment and operates on either line or low voltage.—Julien P. Friez & Sons, Div. of Bendix Aviation Corp., 4 N. Central Ave., Baltimore, Md.

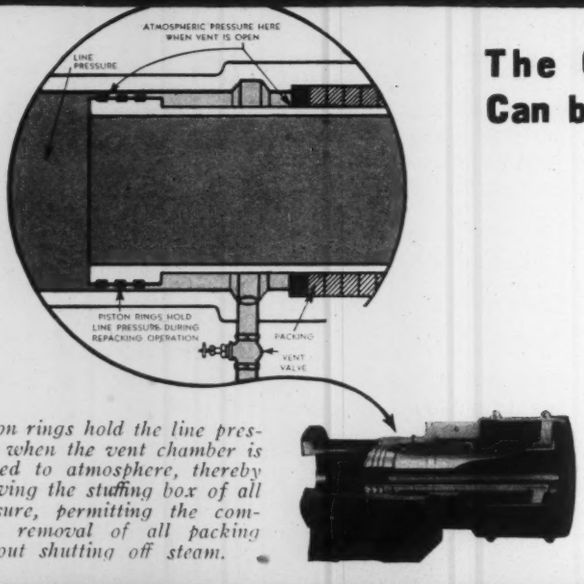
Multi-Speed Motors

No. 2012—New multi-speed motors in two types were announced recently. The "Type M," an open type, is available in sizes ½ to 150 hp, and the totally enclosed "Type MK" comes in a range from ½ to 100 hp.

The open type is recommended by the maker for use where no corrosive or abrasive agents are present to attack the working parts. It can be furnished with either ball or sleeve bearings. The totally enclosed, fan cooled type ball bearing motors are used wherever dust, fumes

ADSCO PISTON-RING EXPANSION JOINT

Can be REPACKED UNDER PRESSURE without Service Interruption


ATMOSPHERIC PRESSURE HERE WHEN VENT IS OPEN
LINE PRESSURE
PISTON RINGS HOLD LINE PRESSURE DURING REPACKING OPERATION
PACKING
VENT VALVE

Piston rings hold the line pressure when the vent chamber is opened to atmosphere, thereby relieving the stuffing box of all pressure, permitting the complete removal of all packing without shutting off steam.

The ONLY Slip Type Joint which Can be UNPACKED UNDER PRESSURE

This exclusive piston ring feature enables you to remove ALL the packing and insert a complete set of NEW packing rings without interruption to service when infrequently necessary to repack this joint.

This is but the latest of many ADSCO improvements in slip type expansion joints during the past 60 years.

Equally important for dependable joint operation are these ADSCO features—correctly proportioned stuffing boxes; polished slips of time-tested material for ease of movement; positive limit stops prevent overtravel of slip; practical internal and external guides for proper alignment and pressure fittings for replacing lubricant in the packing thereby keeping it pliable and prolonging its life.

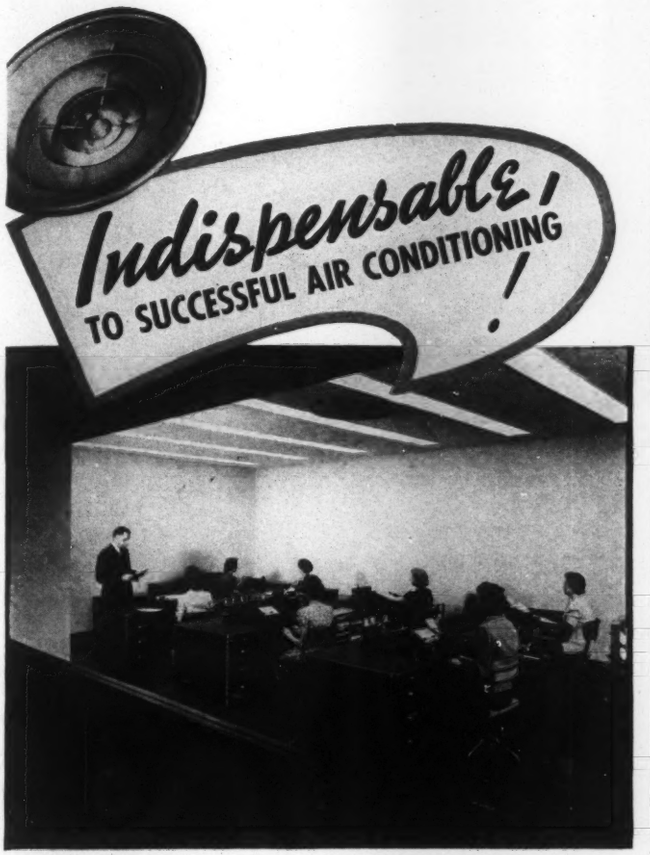
You get all of these features in ADSCO Slip Type Expansion Joints at no price premium over comparable types of joints.

Write for ADSCO Catalog No. 35HP.

AMERICAN DISTRICT STEAM COMPANY

NORTH TONAWANDA, N.Y.

IN BUSINESS OVER SIXTY YEARS



Here is a view of one of the offices in the new windowless "controlled conditions" building recently completed by the Austin Co. for the All-Steel-Equipment Co. at Aurora, Ill.

All of the heating and air conditioning delivery ducts in the building are equipped with

ANEMOSTAT
DRAFTLESS AIR DIFFUSERS

These attractive units are the means by which the conditioned air is introduced and diffused throughout the rooms. But what makes them indispensable to successful air conditioning is the fact that they guarantee ideal air distribution. As a result of scientific design, ANEMOSTATS **positively eliminate drafts** and **equalize temperature and humidity**. That's why more and more Architects and Engineers are specifying them—that's why they are being added to hundreds of existing systems—that's why you now see ANEMOSTATS in so many conditioned offices, stores, restaurants, hotels, schools, hospitals, theatres, factories and residential buildings throughout the country.

WRITE FOR ANEMOSTAT DETAILS

Literature telling how ANEMOSTAT's scientific design assures ideal air distribution and why it cannot fail will be sent on request. Also included is data about types, capacities, selection and installation. **Write for it today.**

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"NO AIR CONDITIONING SYSTEM IS BETTER THAN ITS AIR DISTRIBUTION"

MODERN AIR CONDITIONING FOR MODERN BUILDINGS...

IN 1941 *SPECIFY*
KATHABAR

● This new year brings a larger opportunity—and a bigger task—to the air conditioning engineer. People, products and materials have greater need than ever before of the advantages conferred by specially created atmospheres. This ultra-modern building of Gelatine Products Company is typical of the structures in which Kathabar today is meeting requirements of comfort and industrial processing never before satisfactorily served.

As you look ahead to the varied and complex conditions that will challenge your special knowledge in 1941, be assured that Kathabar gives positive control of vapor pressure—i.e., humidity—regardless of temperature.

Kathabar Humidity Control Units can be admitted into any specifications, can be used with any equipment for regulation of temperature, and are readily accommodated in available space. Let us send you complete data.

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WHAT IS KATHABAR?

Kathabar applies the unique qualities of a chemical called Kathene, the vapor pressure or humidity of which easily can be changed at will. Air coming in contact with Kathene automatically tends to the vapor pressure of the Kathene, thus creating in treated air any desired humidity with absolute precision regardless of weather. Kathene also cleans and deodorizes the air. Kathene is non-inflammable, non-explosive, odorless and inherently harmless. The Kathabar unit is compact, readily accommodated in practically any space and controlled by the simple action of a single valve.

● FOR COMFORT—in hotels, restaurants, public buildings, office buildings, factories, stores, theatres and recreation places.
● FOR HEALTHFUL COMFORT—in hospitals and institutions.
● FOR CONTROLLED DRYING—in factories where materials and their by-products must be dried under controlled conditions.
● FOR SPECIAL ATMOSPHERES—in industries where air conditions affect materials, processes and products.
● FOR DRY BLAST—in cupola and blast furnaces where conditioned air is required in combustion.

FOR 34 YEARS
THE LARGEST MANUFACTURERS OF GAS-FIRED EQUIPMENT EXCLUSIVELY

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for direct expansion air cooling, supplied complete with distributor and valve. Made of suitable material for ANY refrigerant. Absolutely pressure-tight.

Our Bulletin 406 describes our short method of selecting a coil. Send for it, free of charge.

We invite you to see our interesting exhibit, booth 154-5, at the All-Industry Refrigeration Show, Chicago.

MARLO COIL COMPANY

6135 Manchester Avenue St. Louis, Missouri

Manufacturers of heat-transfer surface for any application.

More work from your PRESENT BOILER

Maybe your boiler is ***not*** too small for the work you want it to do. Perhaps the extra capacity you need is being wasted—wasted in one of the three ways shown below. If you find one or all of them, you will find extra capacity you didn't know you had. Wastes can be:

*1. **Steam leaks through the steam traps.*** These are common in old traps, traps that need repair and traps that by their nature are always open for steam to leak past. Changing to Anderson Super-Silvertop traps will save that steam, maybe enough to equal the needed capacity.

*2. **Carrying higher steam pressures*** than normal by forcing the boiler, in order to get desired temperatures. This is usually due to air in the system caused by inefficient trapping. Such air mixes with the steam and reduces the *effective* temperature (that due to steam alone) so that equipment temperature is less than it should be. Efficient trapping with Super-Silvertops will remove all air and give the desired temperature at a lower boiler pressure.

*3. **A trapless system,*** where pressure differential is too low to produce sufficient steam flow, resulting in a low rate of heat transfer. Efficient trapping of such a system increases steam flow and heat transfer so that more work is done with the same boiler.

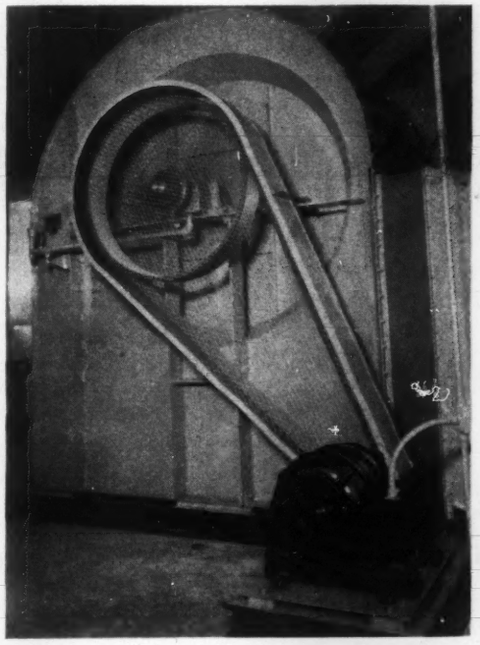
If any of the above conditions are present in your plant, you can do more work with your present boiler by changing to Anderson Super-Silvertop steam traps. Write today for complete information on efficient trapping—send for your copy of "How To Choose a Steam Trap."

THE V. D. ANDERSON COMPANY

1949 West 96th Street • Cleveland, Ohio

Super-Silvertop STEAM TRAPS

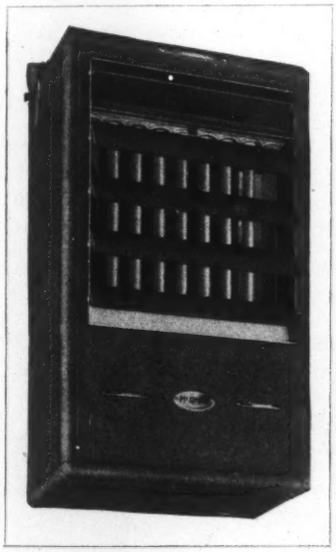
or moisture make necessary frequent rewinds on open type motors. They may be had in any required design, vertically mounted, with special end plates, special bases, etc.



The illustration shows a four speed, variable torque, multi-speed motor driving a large fan in office air conditioning service.—Howell Electric Motors Co., Howell, Mich.

Gas Fired Unit Heater

No. 2013—The gas fired unit heater illustrated is a self-contained unit for garages, airplane hangars, cellarless buildings, etc.

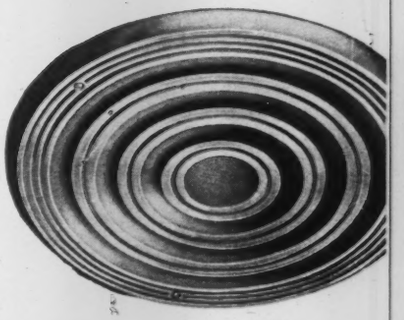


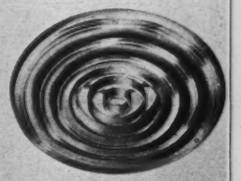
Control is as follows: The room thermostat closes the fan motor and transformer circuits simultaneously, the transformer energizing the solenoid gas valve to open it. A thermostatic pilot and fusible wire safety limit control are provided to open the solenoid circuit, thus shutting off the gas supply if the pilot becomes extinguished, or if the safety wire fuses out. The solenoid gas valve can remain open only if the pilot is ignited and the fan operating. These heaters are of the suspended type and seven models are available with capacities from 65,000 to 255,000 Btu.—McQuay, Inc., 1601 Broadway, N. E., Minneapolis, Minn.

Motor Blowers for Industrial Use

No. 2014—A new "Type G" motor blower unit for general industrial use has recently been developed. Its

In these days of modern merchandising air conditioning has become a "must" with most progressive stores. The Aerofuse Outlet, essentially flush with the ceiling line and simple in design to harmonize nicely with any decorative plan, fits ideally into this picture. Combining beautifully and naturally with almost any type of lighting fixture, its unobtrusive functional superiority is responsible for its growing popularity. Efficiently it provides (1) Maximum Air Mixture, (2) Rapid Temperature Equalization, (3) Perfect Air Distribution, (4) Total Elimination of Drafts.





. . . . And No
A SUPPLY AN
RETURN UNI

Valuable in installatio
where simplification of
duct layout is of prima
importance. Supply and
turn (exhaust) ducts can
run to the same point.

Send at once for Free Brochure fully describing the Aerofuse Outlet.

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NEW YORK CHICAGO PHILADELPHIA

HOW DOES YOUR PRINT-MAKING EQUIPMENT COMPARE WITH THE NEW OZALID MODEL "F"?

OZALID MODEL "F"

Your Equipment

4. Is it a single, self-contained unit? YES
5. Can you save by use of cut sheets? YES
6. Lowest priced for its production class? YES
7. Are prints dry-developed and true-to-scale? YES
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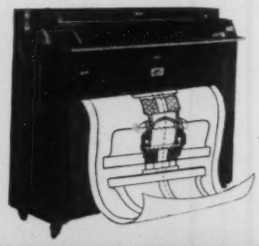
9. Does design enable one operator to handle capacity production? YES
10. Can you make dry-developed transparent duplicates for short cuts in drafting? YES



SEND FOR FREE MODEL "F" CIRCULAR

OZALID PRODUCTS DIVISION
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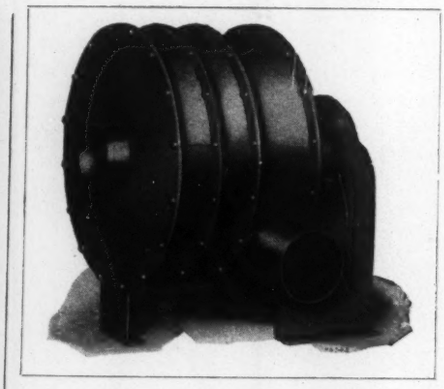


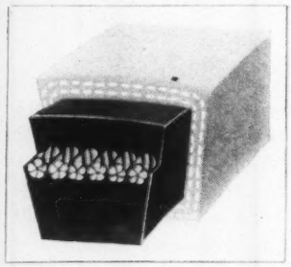
features, according to the manufacturer, are that it is reliable, and quiet in operation, maintains constant pressure, is easy to install and maintain, and is available in a complete range of sizes (pressures ½ to 2¼ lb, volumes 100 to 4500 cfm).

Overhung construction is used with lightweight impellers which are carefully balanced before assembly. Motors are of standard construction and have grease packed ball bearings. There are no close internal clearances. A simple labyrinth packing encloses the rotor shaft at the back plate to prevent leakage.

The fabricated base is an integral part of the back plate of the blower casing, which holds the motor and blower shaft in exact alignment, the maker states.—Ingersoll-Rand Co., 11 Broadway, New York, N. Y.

Oil Proof Belts

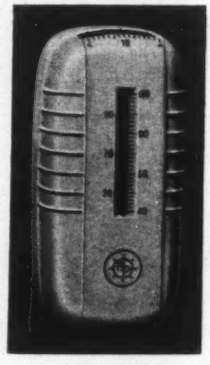
No. 2015—New "Oil-Proof Gripbelts" made of synthetic gums have been placed on the market within the last few weeks. According to the manufacturer, oil, gasoline and similar materials have no harmful effect on these v-belts and they are also resistant to many acids, alkalies and other chemicals. It is also stated that they may be used at continuous temperatures of 150 F or peak temperatures of 200 F with good results. A third feature is that they are non-sparking.

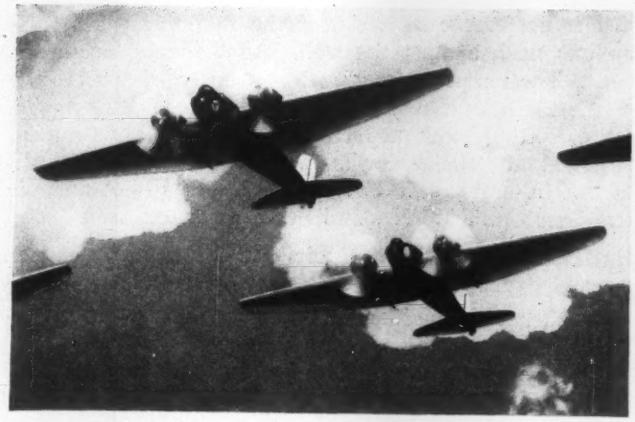


These belts are matched at the factory and the distributors also have matching machines which permit the purchase of closely matched sets of belts from stock, the maker states.—Browning Mfg. Co., Inc., 1940 Browning Blvd., Maysville, Ky.

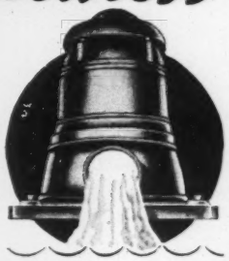
Wall Thermostat

No. 2016—Completely redesigned for increased operating efficiency and more simplified installation, the new "Series 88-S" thermostat combines many new construction features, according to the maker. Among the changes which have been embodied in the design is a new type of "floating mounting." This is accomplished by means of a three point mounting arrangement designed to prevent the base from warping and throwing the unit out of calibration. A fiber wiring board fits against the wall to simplify installation and act as an insulator for the wiring.





IF YOU *Believe In Preparedness*



—Remember that water has always been, is now, and forever will be one of your most vital needs. It is an absolute necessity for MEN, MACHINERY AND MATERIALS. Your present water supply may not be adequate for expansion—or emergency. It may be costing you too much. It may need enlarging.

Now is the time to practice preparedness. Without delay you may secure the cooperation of Layne Engineers who will check your present water supply and offer valuable recommendations on increasing volume or the lowering of operation cost. Behind these Engineers stand the world's foremost water developers; an organization equipped and capable of making dependable preliminary investigations, reconditioning old wells, drilling new ones, furnishing and setting pumps for a complete Well Water Supply System.

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LAYNE-NEW YORK CO. . NEW YORK CITY AND PITTSBURGH . . . . . PA.
LAYNE-NORTHWEST CO. MILWAUKEE, WIS.
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If you want facts about Layne Well Water Supply Systems, Layne Vertical Turbine Pumps, etc., with views and details about worldwide installations, write for illustrated literature. Address,

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PUMPS & WELL WATER SYSTEMS

For Municipalities, Industries, Railroads, Mines and Irrigation

In RADIO STATIONS CHURCHES HOSPITALS—

WHEREVER *Quiet* IS ESSENTIAL—

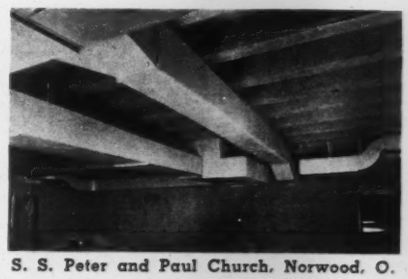
USE *Careyduct* THE ALL-ASBESTOS INSULATED DUCT

FOR AIR CONDITIONING SYSTEMS

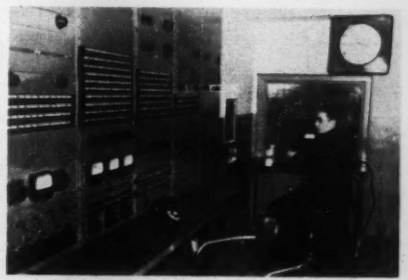
CAREYDUCT combines both duct and insulation. Made entirely of asbestos, it hushes fan and other equipment noises; cuts down outside noise; eliminates metallic "cracking" due to change in air pressure or expansion strain.

Research Building, Children's Hospital, Cincinnati

Especially desirable for use in air conditioning of churches, hospitals, radio studios—wherever noise is objectionable.



S. S. Peter and Paul Church, Norwood, O.



Control Room, Radio Station WCKY, Cincinnati

CAREYDUCT is fireproof, rust-proof, permanent. Simple slip-joint construction and standardized parts make fitting on job easy. Surprisingly economical. Write for interesting CAREYDUCT Manual — Address Dept. 25.

THE PHILIP CAREY COMPANY • Lockland, Cincinnati, Ohio
Dependable Products Since 1873
BRANCHES IN PRINCIPAL CITIES

Look What You Save

You know that welding balls, pipe chips, dirt or sediment may cut and ruin valve seats the first time a valve is opened.

Renewal of the *screwed-in* type of seat is difficult and expensive under favorable conditions, and almost impossible without removing the valve from the line. Care must be taken not to strip the threads in the valve body or the valve must be scrapped. And after seats have been removed, facing and fitting new rings to a tight seat is expensive and time consuming.

New rings can be inserted in a Fairbanks *Renewable* Iron Body Gate Valve by one man in from 10 to 30 minutes—depending on the location and size of valve—without removing it from the line.

Therefore it saves enough time and money in one or two renewals to pay for itself.

You can get Fairbanks Valves from distributors in any large city.

Write for Catalog No. 21.

1. Remove Bonnet.
2. Unlock Seat Rings.
3. Lift out Seat Rings.
4. Insert new rings. Tapered lugs on rings fit into corresponding machined slots in valve body.

Valve illustrated is Fig. 0340

See our exhibit at booth 78, National Exposition of Power & Mech. Eng. Dec. 2 to 7.

THE FAIRBANKS COMPANY

Valves, Dart Unions, Hand Trucks, Truck Casters and Wheelbarrows

396 Lafayette St., New York, N. Y.

Boston, Mass. Pittsburgh, Pa.—Distributors in Principal Cities.

Factories: Binghamton, N. Y., Rome, Ga.

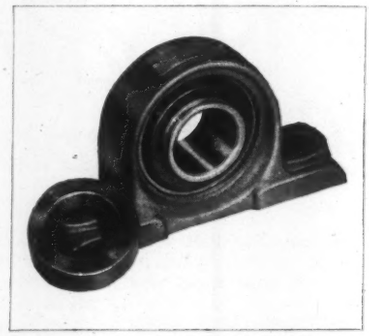
Fairbanks Renewable Valves

The die cast case fits over the thermostat base and mounts flush against the wall. An "Alnico" magnet is used. The temperature adjustment control is on the top of the thermostat to make it possible to adjust temperature setting without stooping, with the instrument mounted at "chair" level. Temperature range is calibrated in units of 2 F from 55 to 85 F.—Automatic Products Co., 2460 N. 32nd St., Milwaukee, Wis.

Ball Bearing Pillow Blocks

No. 2017—A new series of ball bearing pillow blocks and other transmission units incorporating "Mechani-Seal" ball bearings has been announced.

The new streamlined light series pillow blocks, flange cartridges and cylindrical cartridges offer two advantages, for in addition to the efficiency of the construction, they offer ease of application made possible by the wide inner ring design, with self-locking collar, the maker says. They are locked to the shaft with a finger twist, and no machining, shaft shoulders, adapters or lock nuts are required, it is said.



The "Mechani-Seal" bearing, employing close tolerances for its efficiency, imposes no friction or drag, according to the maker. Two steel plate shields form the innermost members. They are tightly fitted to the bearing outer ring. An outer, corrosion proofed, steel plate shield, pressed on the inner ring, clears these inner plates by definite but close tolerances, and acts as an efficient slinger. After prolonged tests in a dust box "torture chamber," these bearings showed no contamination whatsoever of the grease within them, it is stated.

The new transmission units, interchangeable with the separately sealed units which preceded them, are available in "Types LAK" (pillow block), "LCJ" (flange cartridge) and "LC" (cylindrical cartridge).—Fafnir Bearing Co., 37 Booth St., New Britain, Conn.

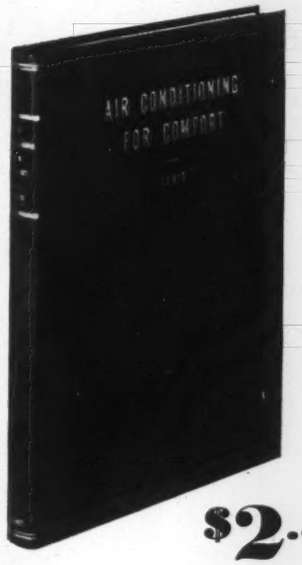
Spot Cooler

No. 2018—A new "spot cooler" has been introduced for use in comfort cooling applications or for product refrigeration.

It is offered in six sizes with a capacity range of from 0.075 to 5 tons of refrigeration and includes a fan, motor, cooling coils, drip pan, two way adjustable louver type air grilles, expansion valves and a suction liquid refrigerant heat interchanger.

It is of the suspension type to conserve

IMPROVE YOUR KNOWLEDGE OF AIR CONDITIONING



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The Third Edition
of Samuel R. Lewis'

"AIR CONDITIONING FOR COMFORT"

288 Pages—6¼" x 9¼"—Illustrated—
Cloth Bound—$2.50

Here is a book that presents—in simple, readily understandable form—every kind of information necessary for an accurate and thorough knowledge of air conditioning principles, equipment, and practices. Written by S. R. Lewis, a widely-known consulting engineer who has been active in air conditioning work for more than thirty years, it deals with all angles of the air conditioning subject from the practicing engineer's viewpoint. The designing procedures explained in the book are, for example, in every detail the same procedures employed today by the author's own organization.

Featuring this third edition are several entirely new chapters on phases of the subject not previously treated, including noise control, air conditioning measurements, air conditioning standards, fire protection codes and operating suggestions. Brand new designing examples are also used, together with new forms for recording the design data, the proper filling-in of which is explained step-by-step.

The chapter devoted to Psychrometry presents nineteen different formulas for psychrometric calculations. In illustrating the correct use of these formulas, Mr. Lewis applies both the psychrometric tables and chart in order to render both devices thoroughly understandable. The chart used in this edition is less complex than the one used in his previous book.

OF VALUE BOTH AS A REFERENCE AND TEXT

Engineers in air conditioning will find the new "Air Conditioning for Comfort" invaluable as a reference book, while salesmen, students, and others may rely on it to give them a clear knowledge of fundamentals, and of the latest air conditioning methods and equipment.

Send for a copy today. We know you will consider this volume the most readable and complete book on the air conditioning science you have yet seen. You will risk nothing in ordering a copy, for you will be privileged to return it for a refund if for any reason it should prove unsatisfactory. Use the coupon at the left to order your copy now.

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CONTENTS

CHAP. 1—Terms Used in Air Conditioning
CHAP. 2—Heat and Air
CHAP. 3—Air Conditioning Standards
CHAP. 4—Air Conditioning and the Human Body
CHAP. 5—The Psychrometric Table and Chart
CHAP. 6—Humidity Controllers and Control
CHAP. 7—Heat Transmission Through Barriers
CHAP. 8—Ventilation, Solar and Appliance Heat
CHAP. 9—Heating Systems
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CHAP. 12—Refrigeration and Refrigerants
CHAP. 13—Refrigeration Compressors and Condensers
CHAP. 14—Refrigeration Evaporators and Auxiliaries
CHAP. 15—Record Forms for Heating and Cooling
CHAP. 16—Air Distribution
CHAP. 17—Water in Air Conditioning
CHAP. 18—Noise and Its Control
CHAP. 19—Air Conditioning Instruments and Measurements
CHAP. 20—Codes and Operating Suggestions
10" x 16" Psychrometric Chart..Inside Back Cover

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CURTIS Condensing Units

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Exacting run-in tests are only one of many examples of the care and precision found in every step of Curtis manufacturing methods. The result is the long life, high efficiency and care-free performance of every Curtis Condensing Unit.

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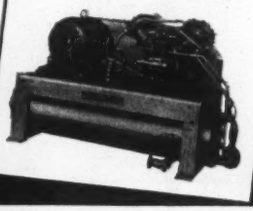

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Write for Bulletin #4013

floor space, and has been tested in spot cooling applications at bowling alleys, theater and restaurant marquees and other places where this type of application is in demand.—Carrier Corp., 302 S. Geddes St., Syracuse, N. Y.

Bronze Globe Valve

No. 2019—A new bronze globe valve "Figure 531-P," recently announced, has a full-plug type seat and disc, designed for throttling services on high temperature and high pressure steam lines. It is also suitable for use on high pressure lines carrying boiler scales and other gritty substances which quickly wear ordinary seating materials, says the manufacturer.

The body is made of a special hard bronze, disc and seat of heat treated stainless steel, 500 Brinell hardness, and the stem is high strength, wear resisting bronze.—Reading-Pratt & Cady Div., American Chain and Cable Co., Inc., 929 Connecticut Ave., Reading, Pa.

Booklets, Reports and Papers

Strength of Soft Soldered Joints in Tubing

Report BMS58 in the building materials and structures series of the National Bureau of Standards is entitled Strength of Soft Soldered Joints in Copper Tubing and was prepared by Arthur R. Maupin and William H. Swanger. Comprising twenty-five 8 x 10½ in. pages, it is available from the Superintendent of Documents, Washington, D. C., for 10 cents.

This paper gives the results of an investigation of the strength, under tensile loading, of sleeve joints in copper water tubing with wrought copper and cast brass couplings soldered with (50-50) tin-lead and (95-5) tin-antimony alloys.

In short time tests (speed of movable head 0.06 in. per min) the strength of the joints was substantially equal to that of the tubing or fittings. The strength varied directly with the depth of insertion of the tubing into the fitting, and was greater at diametral clearances of 0.004 to 0.010 in. between tubing and fitting than at greater clearances. The strengths were higher at 0 F than at 85 F and decreased rapidly as the temperature was further increased.

In long time tests (10,000 hr or more) under constant tensile loads, the strength of joints soldered with tin-lead was about 1/18 of that obtained in short time tests, from 85 F to 250 F; joints soldered with tin-antimony had from 1/5 to 1/7 of the short time strength, depending upon the temperature. At 250 F and upward, diffusion of copper from the tubing into the solder films, in joints made with tin or tin-alloy solders, may weaken or destroy the metallic bond between the solder and tubing.

Results of pulsating tensile load tests, limited to the joints soldered with (50-50) tin-lead, indicated that the

PIONEERING ILG LEADERSHIP

"Firsts"

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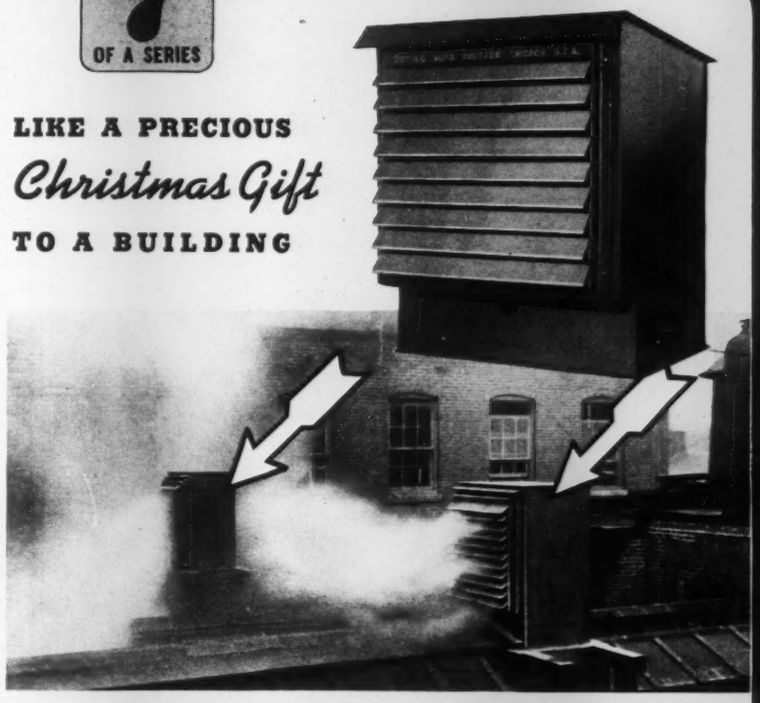
LIKE A PRECIOUS *Christmas Gift* TO A BUILDING



ILG POWER ROOF VENTILATOR

for Positive All-Weather Ventilation

Recognizing the need for a POWER roof ventilator which would remove foul air and fumes *regardless* of the *season*, the *weather* or *wind direction*, ILG scooped the industry way back in 1915. Down through the years, thousands of these *dependable*, weather-tight penthouses have been placed in operation with highly satisfactory results. Enclosing an ILG Propeller Fan with the self-cooled miracle motor that "breathes", the penthouse is fitted with a standard ILG Automatic Shutter and provided with a door in back to give easy access to the fan for periodic oiling. Simple to install—nothing to get out of order or break. Insulation and protective finishes available on request. All Ilg-built, including the motor bearing the famous "ONE-NAME-PLATE" Guarantee. Write today for Catalog F-482 and prices.

OTHER ILG "Firsts"

★ Self-cooled motor propeller fans—patented 1906
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★ Variable air control for blowers—1934
★ Type C (condenser-type) Motors—1925
★ Automatic shutter—1907
★ Motor operated shutter—1918
★ Solenoid operated shutter—1907
★ Propeller fan steam unit heater—1916.
★ Self-contained electric unit heater—1917
★ ILGATTIC system of summer cooling—1918
★ Portable type kitchen ventilating fans—1918
★ Built-in type kitchen ventilating fans—1925
★ Transom type kitchen ventilating fans—1925

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Vitalized VENTILATION AND AIR CONDITIONING

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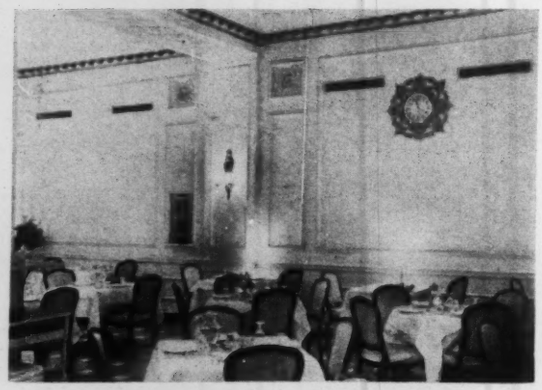
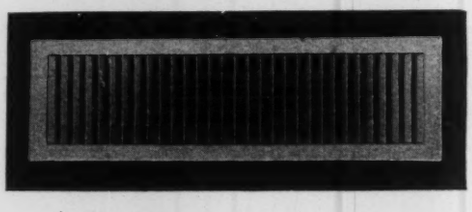
Waterloo
AIR DIFFUSION EQUIPMENT

Makes Conditioned Air DO ITS JOB!



Above: French Room, Hotel William Penn, Pittsburgh, Pa., showing installation of Waterloo Grilles. Below: Close-up view FGV-75 super-flexible grille.



● Air may be properly cooled or heated—thoroughly cleaned—accurately regulated for humidity—and forced to its destination—but unless it is properly diffused, results may be far from satisfactory. That is why so many architects and engineers specify Waterloo Air Diffusion Equipment to control the volume, direction and diffusion of air at each outlet—thus assuring greatest comfort and best performance on every air conditioning installation.

WATERLOO REGISTER COMPANY
Waterloo, Iowa Seattle, Wash.
Representatives in all principal cities.

strength under repeated loading was not less than under steady loading.

In the proposed American Standard for Soldered Joint Fittings, the pressure ratings were based upon the results of the strength tests described in this paper. Results of similar tests on joints made with other less commonly used soft solders are to be given in another paper.

Electrical Code Analyzed

The National Electrical Manufacturers Association, 155 E. 44th St., New York, N. Y., has published an analysis of the 1940 revision of the national electrical code. It describes all changes from the 1937 edition and in many cases enables the reader to see at a glance the effect of the change. In some cases the reason for the change is given.

Copies of the analysis may be had from the NEMA at 25 cents each, with lower prices for copies in large quantities.

Housing for Defense

Defense housing should be of permanent, not temporary construction; it should be concentrated in the low priced field; and government should make every effort to aid and stimulate private building before starting direct operations itself.

Such are some of the major conclusions in a special research report, Housing for Defense, which is being published by The Twentieth Century Fund, 330 W. 42nd St., New York, N. Y. The report was prepared under

DIRTY FILTERS can ruin the efficiency of the best air-conditioning system made....

THIS Hays Air Filter Gage gives a constant check on Air Filter conditions. It prevents changing filters sooner than necessary and warns when they are clogged with dirt.

The Hays Air Filter Gage is permanently and easily installed — nothing to get out of order. Will last as long as the duct work. Write 990 Eighth Avenue, Michigan City, Ind., for special Bulletin No. 40-278.

The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROL
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the supervision of the Fund's committee on housing, whose chairman is Dr. Henry E. Hoagland, professor of business finance at Ohio State University, formerly director of the Home Owners' Loan Corp. and a former member of the Federal Home Loan Bank Board.

Emphasizing the necessity for immediate action, the research report shows that during the World War housing shortages caused an annual labor turnover of 500 to 1000 per cent in some shipyards; caused 50 per cent of women workers sought by labor department placement service to refuse jobs in war industries; and threatened to reduce the output of a major munitions plant by as much as one-third.

As a first step toward avoiding such dangers today the committee urges that the government promptly formulate a national housing policy and make its provisions "clearly and widely known."

The committee says the great need of the present emergency is for low priced housing. The research report shows that for a typical group of defense industries about 30 per cent of the workers will be making an average of $50 per week; another 40 per cent of the workers will average $29 weekly; and the remaining 30 per cent about $20 weekly. The needed housing will have to be suitable for income ranges such as these.

The report contains the first published figures showing the allocation, by cities, of upwards of 6 billion dollars in defense contracts. There is also a table of housing vacancies in the principal cities and centers of defense industry in the United States, indicating that critical housing shortages are already developing in many defense centers.

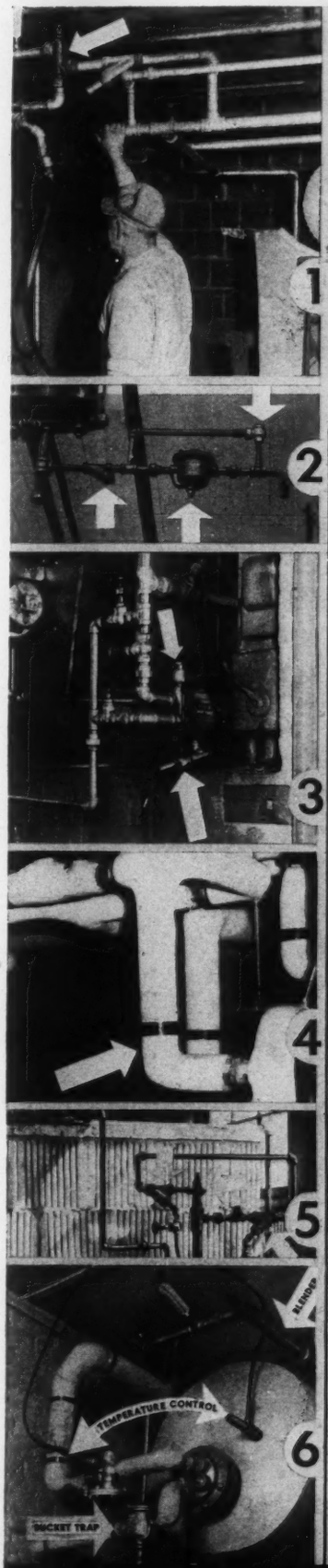
MEMO

FROM: Sales Manager

TO: Adv. Manager

Please make a note of the important message about January 1941 in the December issue of HEATING, PIPING and AIR CONDITIONING.

P. S. You'll find it on page 24.



6

SARCO *Savers*

Sarco saves steam and water. Six examples are shown below. It's a profitable business—both for the plumbing and heating contractor and the customer. Ask for the catalogs.

1

APARTMENT HOT WATER SERVICE. In Milwaukee this janitor no longer gets complaints of "scalding water" and the cost of hot water was materially reduced by the Sarco DB Blender. It delivers tempered water at constant temperature.

2

UNIT HEATERS IN WAX PAPER PLANT. Battery of seventeen equipped with SARCO Inverted Bucket Traps and Strainers. Catalog No. 165.

3

BLAST HEATERS IN FOOD PLANT, equipped with Sarco Float-Thermostatic Traps, blow air on tank cars, reduce time required and lower heating costs. Catalog No. 38.

4

THIS DEPARTMENT STORE uses two large Sarco Water Blenders to insure correct temperatures without waste on the kitchen and domestic hot water service. Catalog No. 140.

5

STEAM MIXER ON SHOWERS in chemical plant in New Jersey. Mixes steam and water and delivers water at correct temperature at all times. Catalog No. 863.

6

SHOWERS IN POWDER PLANT, showing combination of four Sarco products on one job. Sarco Bucket Trap, Strainer, Regulator and Blender on service water heater. Catalogs on request.

SARCO SAVES STEAM

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183 Madison Avenue, New York, N. Y.
SARCO CANADA LTD. FEDERAL BLDG. TORONTO, ONT.

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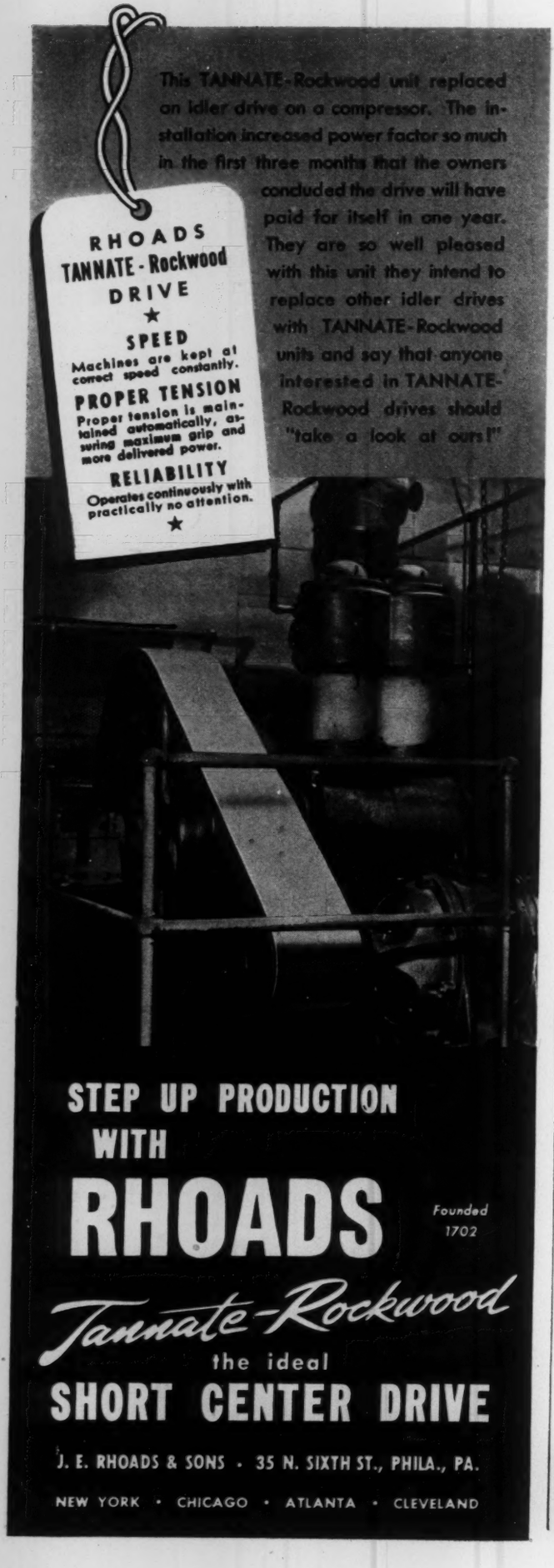
This TANNATE-Rockwood unit replaced an idler drive on a compressor. The installation increased power factor so much in the first three months that the owners concluded the drive will have paid for itself in one year. They are so well pleased with this unit they intend to replace other idler drives with TANNATE-Rockwood units and say that anyone interested in TANNATE-Rockwood drives should "take a look at ours!"
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TANNATE-Rockwood
DRIVE
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SPEED
Machines are kept at correct speed constantly.
PROPER TENSION
Proper tension is maintained automatically, assuring maximum grip and more delivered power.
RELIABILITY
Operates continuously with practically no attention.
★
STEP UP PRODUCTION
WITH
RHOADS
Founded
1702
Tannate-Rockwood
the ideal
SHORT CENTER DRIVE
J. E. RHOADS & SONS · 35 N. SIXTH ST., PHILA., PA.
NEW YORK · CHICAGO · ATLANTA · CLEVELAND

Conventions and Expositions

National Warm Air Heating and Air Conditioning Association: Annual convention, December 10-11, Hotel Statler, Detroit, Mich. Headquarters office, 5 E. Long St., Columbus, Ohio. Program includes talks by Robert K. Thulman, A. P. Kratz and S. Konzo; a question and answer period under the chairmanship of L. R. Taylor; and various committee reports, including one by B. F. McLouth on new editions of the codes.

National Chemical Show: National Chemical Exposition and Industrial Chemical Conference, December 11-15, Stevens Hotel, Chicago, Ill. Under auspices Chicago section, American Chemical Society. Headquarters office National Chemical Exposition, 110 N. Franklin St., Chicago, Ill. A symposium on newer developments in chemistry and chemical engineering will be given.

"All-Industry" Refrigeration and Air Conditioning Exhibition: January 13-16, Stevens Hotel, Chicago, Ill. Sponsored by Refrigeration Equipment Manufacturers Association, R. M. McClure, executive secretary, 111 W. Washington St., Chicago, Ill.

American Society of Heating and Ventilating Engineers: Annual meeting, January 27-29, Hotel Muehlebach, Kansas City, Mo. A. V. Hutchinson, secretary, 51 Madison Ave., New York, N. Y.

LAU PRECISION BUILT
PILLOW BLOCKS
Assure Quiet Performance
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Soft pedal your air conditioning blowers . . . shush metallic bearing noise, by building in *quiet* with LAU PILLOW BLOCKS.

Put precision bearing performance into your product easily, simply, and at low cost. LAU PILLOW BLOCKS are positive self-aligning, light weight, and durable. Housings die formed from heavy gauge steel. Durex Bronze bearings lubricated through pores by capillary action. Wide range of sizes and styles to suit your requirements.

These Pillow Blocks will serve continuously for long periods with minimum attention. Whatever your Pillow Block needs, Lau engineers are equipped to help you. Write for complete information . . . no obligation.

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BLOWERS • FANS • WHEELS • PILLOW BLOCKS
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THERE'S A SALES ENGINEER NEAR YOU

National Oil Burner Progress Exhibition: March 17-22, Commercial Museum, Philadelphia, Pa. Official hotel headquarters, Hotel Benjamin Franklin. Sponsored by Oil Burner Institute, 30 Rockefeller Plaza, New York, N. Y.

Smoke Prevention Association: Annual convention, June 3-6, Ansley Hotel, Atlanta, Ga. Secretary-Treasurer, Frank A. Chambers, Deputy Smoke Inspector, Department of Smoke Inspection and Abatement, City Hall, Chicago, Ill.

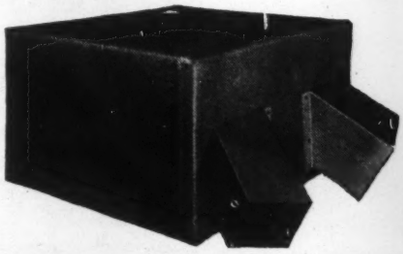
American Society of Heating and Ventilating Engineers: Semi-annual meeting, week of June 16, San Francisco, Calif. A. V. Hutchinson, secretary, 51 Madison Ave., New York, N. Y.

Heating, Piping and Air Conditioning Contractors National Association: Annual convention, week of June 16, Hotel St. Francis, San Francisco, Calif. Headquarters office, 1250 Sixth Ave., New York, N. Y.

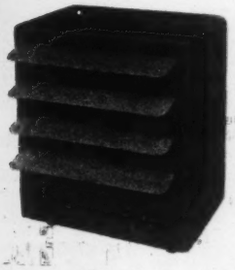
Pacific Heating and Air Conditioning Exposition: June 16-20, Exposition Auditorium, San Francisco, Calif. Under auspices of American Society of Heating and Ventilating Engineers, and under management of Charles F. Roth, International Exposition Co., Grand Central Palace, New York, N. Y. Walter L. Fleisher is chairman of the advisory committee.

American Society for Testing Materials: Annual meeting, and exhibit of testing apparatus, June 23-27, Palmer House, Chicago, Ill. Headquarters office, 260 S. Broad St., Philadelphia, Pa.

Low cost comfort for plant or office . . . electric heat



Type CUB electric unit heater for large areas. Centrifugal blower operated. Thermostatic control. 15 to 40 Kw.



Type HF blower type heater with new streamlined design for individual rooms and offices. Portable, for shelf, floor or wall mounting. Fan can be operated alone for summer cooling. Four sizes 1.5 to 4 Kw. A number of other types available.

CHROMALOX
ELECTRIC AIR HEATERS

give you heating economy in every way. Installation quick and simple. No piping troubles, heat losses, boiler room costs, unnecessary or wasted heat. No waiting for heat, either—the click of a switch brings it, Fall, Winter, Spring, Sundays, holidays, nights. Built for high efficiency by specialists in electric heat. Units to fit all needs—watchman's cabin, factory floor, office. Thermostat or manual control. Sizes 1.5 to 40 kw.

The Chromalox Book of Electric Heat has valuable data on application methods, unit selection for electric heat in all industrial uses. Write for a copy.

EDWIN L. WIEGAND COMPANY
7610 Thomas Blvd. Pittsburgh, Pa.

THE popular Auer "7000" Line offers you substantial quality in air conditioning registers and intakes—at a real saving. This Auer Airo-Flex is carefully made and finished, is of simple construction, without complicated parts or installation problems.

It gives you fine appearance and unusual economy. The "7000" Register is adjustable for directional flow control—up, straight, or down. Grille bars are set, when delivered, for 22½° downward deflection, but are easily adjustable for other angles. These registers are equipped with single louvre and made in a complete line for wall and baseboard use.

Ask for complete Auer Register Book 40, and name of your nearest Auer distributor. Separate Catalog "G" also available on Auer Grilles.

THE AUER REGISTER COMPANY
3608 Payne Avenue Cleveland, Ohio

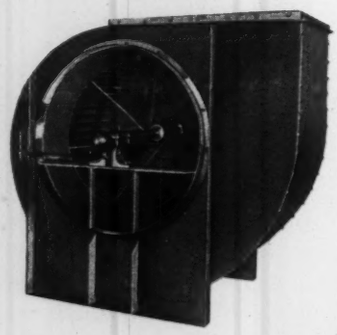
AUER REGISTERS
& GRILLES
For Air Conditioning *and* Gravity

for ANY HEATING and VENTILATING Requirement SPECIFY BISHOP & BABCOCK EQUIPMENT

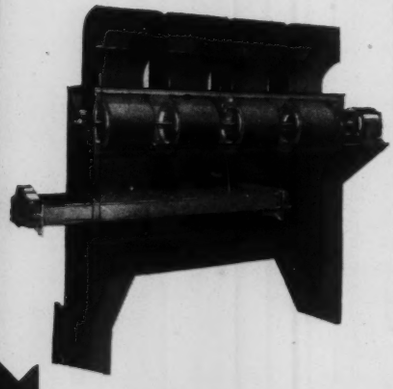
Serving the Industry since 1879

VENTILATING FANS

Whatever your ventilating problem, you will find a practical economical solution in selecting a Bishop and Babcock product. With the Squirrel Cage Type Fan made in all standard sizes from 6" diameter wheels to as large as 96", delivering from 250 to 500,000 C.F.M., combined with the Streamline Fan in standard wheel diameters from 18" to 75", you can specify a Bishop and Babcock unit for any ventilating requirement.



UNIT HEATERS



There is a size and model Bishop and Babcock Steam or Hot Water Unit Heater to meet your every requirement. Propeller Type and Blower Type for both ceiling and floor mountings in a complete range of sizes. Full information is available, write for bulletins.

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Recent Trade Literature

For your convenience in obtaining copies of these bulletins, see coupon on page 104. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending your request to HEATING, PIPING AND AIR CONDITIONING.

No. 3712. AIR COMPRESSORS: Worthington Pump & Machinery Corp., Harrison, N. J. Mailing piece on small air compressors for industrial service available in a wide range of capacities, pressures and mountings, describing features.

No. 3713. AIR CONDITIONING: Carrier Corp., 302 S. Geddes St., Syracuse, N. Y. Pamphlet (AC-133) outlining 1294 ways the manufacturer aids industry, business and the home by means of air conditioning, refrigeration and heating equipment.

No. 3714. BEARINGS: Keystone Carbon Co., Inc., St. Marys, Pa. 24 p. catalog on "Selflube" porous bearings with list of sizes and code numbers. Called "the bearings with a million oil wells" they are the result of research in the processing of powdered metals and are offered for the solution of problems dealing with bearing and allied applications where self-lubrication is a vital factor.

No. 3715. CHEMICAL PUMPS: %Proportioneers, Inc.%, 9 Codding St., Providence, R. I. Bulletin (TOU-6) describing complete line of chemical feeding

Any range 15 F.P.M. to 24,000 F.P.M.

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You can save time and know whether your heating and air conditioning jobs are right when you use the "ALNOR" Velometer. Without timing or complicated mathematical calculations the Velometer gives direct, accurate, instantaneous air velocity readings. Many users report that with the Velometer they can check and balance a system in one-tenth the time formerly required, and the Velometer gives them a picture of air distribution that no other instrument can. Write for details.

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- Very Low Pressure Drop
- No Replacements Needed
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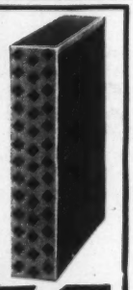

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Air-Maze is in the A.S.H. & V.E. 1940 Guide Book

AIR-MAZE
CLEANABLE AIR FILTER PANELS

equipment for boiler water conditioning and for increasing heat transfer efficiency of condensers.

No. 3716. CONTROLS: Spencer Thermostat Co., 43 Forest St., Attleboro, Mass. 32 p. catalog of "Klixon snap acting" controls for heating and air conditioning equipment. Of particular interest is a new line of electric diaphragm gas valves and other controls for automatic gas burning equipment.

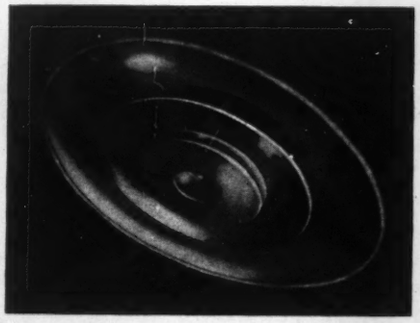
No. 3717. DEHYDRATORS. Carrier Corp., 302 S. Geddes St., Syracuse, N. Y. 2 p. data sheet (53C-5) on automatically operated self-contained dehydrator embodying principle of moisture removal from air by adsorption with silica gel. Unit is available in four sizes and utilizes gas or steam heat for activation.

No. 3718. ELECTRODES: Air Reduction Sales Co., 60 E. 42nd St., New York, N. Y. Electrode selector chart for use by arc welding operators, listing according to the metal to be welded the suggested type of electrode, welding procedure and recommended voltage and current values.

No. 3719. FUELSTATS: Tuthill Pump Co., 939 E. 95th St., Chicago, Ill. Two new bulletins covering complete details of operation, application and service on single stage and two stage fuelstats.

No. 3720. GRILLES: Carrier Corp., 302 S. Geddes St., Syracuse, N. Y. 2 p. specification sheet (AC-134) describing new grille type outlets available in 32 standard sizes, designed to give complete air distribution.

No. 3721. HEAT TRANSFER SURFACE: Thermek Corp., 105 W. Adams St., Chicago, Ill. 24 p. bulle-



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★ Draftless
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★ Union Made

Efficient When Mounted on Either Exposed or Concealed Duct Work

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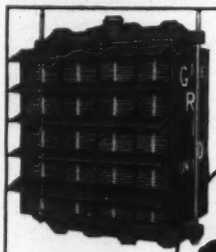

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Wausau, Wisconsin
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✓ W-S Socket Welding Fittings simplify and speed up the installation job.

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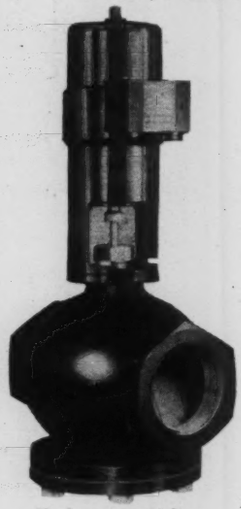
Forged Steel Fittings

NEW MOTOR OPERATED VALVE

All purpose General Controls Hydramotor controls water, air, gas, gasoline, oil, brine, saturated steam, *accurately* and *positively*.



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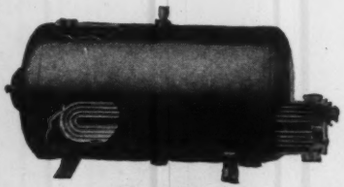
107 Warren St.
East Stroudsburg, Pa.



Patterson Everdur or Copper-Lined Hot Water Heaters

tin (440) entitled More Heat Transfer per Foot comprising an engineering manual describing in detail how integrally spined, extended surface tubing can be used to reduce size, weight and cost of all types of heat transfer equipment. Extensive tabulations of over-all heat transfer coefficients and product design information are presented.

No. 3722. HOSE: Pennsylvania Flexible Metallic Tubing Co., 72nd St. and Powers Lane, Philadelphia, Pa. 8 p. bulletin (59-G) on "Penflex" galvanized steel hose and couplings; 8 p. bulletin (52-G) on bronze steam hose and clincher couplings; and data sheet (60) on all-metal general utility hose for ventilation, loose material handling, etc.

No. 3723. INSTRUMENTS: General Electric Co., 1 River Rd., Schenectady, N. Y. 4 p. bulletin (GEA-2753) on electrical instruments and time switches, describing how they may be used "to increase plant efficiency and save money."

No. 3724. INSULATING BRICK: A. P. Green Fire Brick Co., Mexico, Mo. 8 p. technical data bulletin on insulating fire brick for use in direct contact with flame and furnace gases. Interesting information on selection is included.

No. 3725. MOTORS: Howell Electric Motors Co., Howell, Mich. 4 p. bulletin (M-50) on multispeed motors available in open and totally enclosed types, for use in air conditioning, ventilation and for industrial service.

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Send for this 16-page insulation manual.

The Pacific Lumber Company
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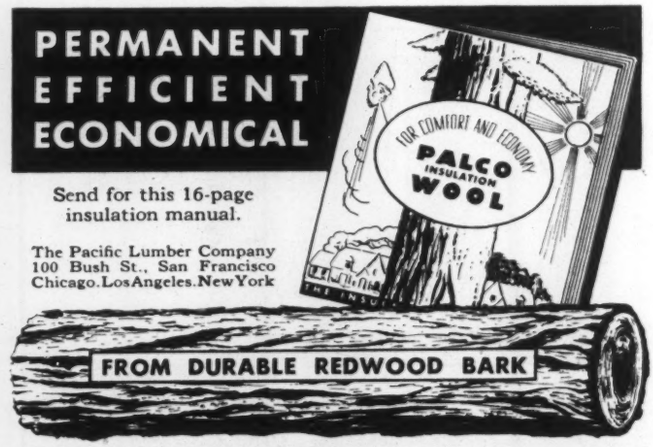
Chicago. Los Angeles. New York



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VENTILATING FANS
COMPLETE DUCT AND EXHAUST EQUIPMENT

Certified Ratings AMCA

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INTERNATIONAL ENGINEERING, INC.
New York, 15 Park Row — DAYTON, OHIO — Chicago, 407 S. Dearborn St

No. 3726. PIPE AND TUBING: International Nickel Co., Inc., 67 Wall St., New York, N. Y. 12 p. technical information bulletin (T-17) on the fabrication of "Monel," nickel and "Inconel" seamless pipe and tubing with data on properties and design, bursting pressure, fabrication (including machining, welding and bending and coiling), with an appendix on available forms, tolerances and accessory items and a listing of information bulletins on these alloys.

No. 3727. POWER PLUGS: Howard B. Jones, 2300 Wabansia Ave., Chicago, Ill. 8 p. bulletin (500) on the "500 Series" line of power plugs and sockets designed for 5000 volts and 25 amp and made in 2, 4, 6, 8, 10 and 12 contacts.

No. 3728. PUMPS AND PUMP PARTS: International Nickel Co., Inc., 67 Wall St., New York, N. Y. 16 p. booklet on practical pumping problems and how they are solved, discussing uses of "Monel," "K Monel" and "S Monel" for pump parts in applications where there is need for high resistance to corrosion, wear, pitting or scoring. Reciprocating, centrifugal and rotary type pumps are covered and part of the booklet is devoted to a review of case histories.

No. 3729. REFRACTORIES: General Refractories Co., Broad and Chestnut Sts., Philadelphia, Pa. 48 p. export booklet entitled World-Wide Refractories Service, printed in both English and Spanish, covering major types of refractories and their uses, methods of shipment for export, and giving 10 pp. of engineering data tables.

No. 3730. REFRIGERATION COMPRESSORS: Carbondale Div., Worthington Pump and Machinery

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A DART
GET ITS
"SECOND
WIND"

Dart Unions consistently get off to a good start, make up tight quickly, stay tight unfailingly. But the most important ability of Darts shows up best in the long run: Take down a Dart, *re*-install it, and you'll find it holds the same stride, assures the same dependable tightness as the first time installed. . . . It's just plain, common-sense economy to take advantage of Darts *repeated-use*. It assures you lower cost-per-tight-joint. So next time you change or add piping, use Darts and save.

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SALES AGENTS: THE FAIRBANKS COMPANY, CANADIAN FACTORY: DART UNION COMPANY LTD. TORONTO CANADA

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✓ Convenient
✓ Complete

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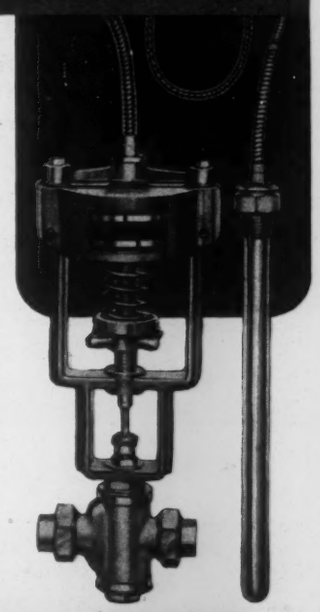
KEENEY PUBLISHING COMPANY
6 North Michigan Ave. Chicago, Ill.

TANK REGULATORS



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Corp., Harrison, N. J. 6 p. bulletin (C-1100-B11) on vertical, two cylinder refrigeration compressors in sizes 5 in. by 5 in. and smaller, with roller bearings and equipped with feather valves. Features of design and specifications are included.

No. 3731. SEAMLESS TUBULAR PRODUCTS: Babcock & Wilcox Tube Co., Beaver Falls, Pa. Technical bulletin (11-C) of specifications for seamless tubular products covering manufacture, finish and workmanship, chemical and physical properties, tests and permissible variations in weights and dimensions of tubes and pipe.

No. 3732. SHEET METAL MACHINERY: Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y. 66 p. booklet (106-A) giving condensed resumé of manufacturer's line of presses, pumps, squaring shears and rotary shears.

No. 3733. SMOKE HOUSES: Carrier Corp., 302 S. Geddes St., Syracuse, N. Y. 4 p. bulletin on air conditioned smoke houses, dealing with meat smoking, cooking and showering operations, all of which are combined in the unit.

No. 3734. SUN SCREEN: Ingersoll Steel & Disc Co., 310 S. Michigan Ave., Chicago, Ill. 12 p. booklet of representative installations of "KoolShade" sun screen showing views of numerous buildings equipped with the screen and presenting letters telling how it performs in actual service. A list of typical users is appended.

No. 3735. VACUUM RETURN UNITS: Ames Hydrovac Corp., 290 Scholes St., Brooklyn, N. Y. 8 p. bulletin (100) on vacuum return units, gravity return units and pyramid motor pumps "for use with modern types of selective pressure and temperature control, vacuum and gravity return line heating systems." Dimensions, specifications and Hydraulic Institute standards are included.

No. 3736. ZINC: American Zinc Institute, 60 E. 42nd St., New York, N. Y. 30 p. booklet on the zinc industry (by Ernest V. Gent, secretary of the Institute) discussing history, amount of zinc used, production of zinc, marketing of zinc, etc. (not intended as a technical treatise but to give a rather complete picture of the industry).

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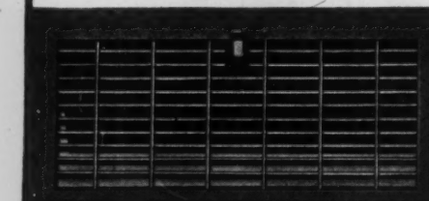
No. 311-A *adjustable* DIRECTED AIR FLOW REGISTERS *and* GRILLES



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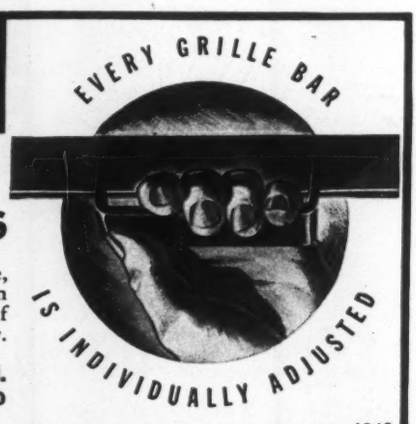

1040

HEATING + PIPING AND AIR CONDITIONING

January, 1940

DIRECTORY SECTION

HEATING, PIPING AND AIR CONDITIONING EQUIPMENT *for* INDUSTRY AND LARGE BUILDINGS

HOW TO USE THIS DIRECTORY

If you want to know the names of one or more manufacturers making a certain product, look in Part 1, where that product will appear in its proper place in the listing. If you have the trade name of a product and want to know who manufactures it, look in Part 2, where trade names are alphabetically listed. For the complete name and address of any manufacturer look in Part 3.

● The manufacturers whose names are spotted throughout the listings advertise in this issue. See Index to Advertisers (on next page) for the page on which you will find the advertising of any of these manufacturers.

Heating, Piping and Air Conditioning, Chicago, Ill.

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See Machines, Refrigeration, Absorption

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Boester, Carl F., St. Louis, Mo.
●Frick Co., Waynesboro, Pa.
●McQuay, Inc., Minneapolis, Minn.
●Vilter Mfg. Co., Milwaukee, Wis.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
X L Refrigerating Co., Chicago, Ill.

ADJUSTABLE WRENCHES
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ADSORBERS, ODOR
Betz Corp., Hammond, Ind.
Connor Engineering Corp., W. B., Dorex Air Conditioning Div., New York, N. Y.

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Bacharach Industrial Instrument Co., Pittsburgh, Pa.
Barclay, Inc., Robert, Chicago, Ill.
Defender Automatic Regulator Co., St. Louis, Mo.
Dwyer Mfg. Co., F. W., Chicago, Ill.
Ellison Draft Gage Co., Chicago, Ill.
Engelhard, Inc., Chas., Newark, N. J.
Friez & Sons, Julien P., Baltimore, Md.
Hays Corp., Michigan City, Ind.
Hotstream Heater Co., Cleveland, O.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
Preferred Utilities Mfg. Corp., New York, N. Y.
Service to Industry, West Hartford, Conn.

ANEMOMETERS
American Instrument Co., Silver Spring, Md.
Bristol Co., Waterbury, Conn.
Friez & Sons, Julien P., Baltimore, Md.
Hill, E. Vernon, Chicago, Ill.
●Illinois Testing Laboratories, Inc., Chicago, Ill.
Precision Thermometer & Instrument Co., Philadelphia, Pa.
Taylor Instrument Companies, Rochester, N. Y.
Willson Products, Inc., Reading, Pa. (Thermometer type)

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ANGLES, BARS, BEAMS, CHANNELS AND TEES (LIGHT WEIGHT SHAPES)
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●American Brass Co., Waterbury, Conn.
Bethlehem Steel Co., Bethlehem, Pa.
●Byers Co., A. M., Pittsburgh, Pa.
●Carnegie-Illinois Steel Co., Pittsburgh, Pa.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Colonial Alloys Co., Specialties Div., Philadelphia, Pa.
●Columbia Steel Co., San Francisco, Cal.
Inland Steel Co., Chicago, Ill.
International Steel Co., Evansville, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Laclede Steel Co., St. Louis, Mo.
Lukens Steel Co., Coatesville, Pa.
Milcor Steel Co., Milwaukee, Wis.
●Republic Steel Corp., Cleveland, O.
Revere Copper and Brass, Inc., New York, N. Y.
Stran-Steel Div., Great Lakes Steel Corp., Detroit, Mich.
●Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.
Truscon Steel Co., Youngstown, O.
Weirton Steel Co., Weirton, W. Va.
●Youngstown Sheet & Tube Co., Youngstown, O.

AQUASTATS
See Thermostats

ARC WELDERS
See Welders, Arc

ARC WELDING ELECTRODES
See Electrodes, Arc Welding

ASBESTOS FIBER AND CEMENT PIPE
See Pipe, Asbestos Fiber and Cement

ASBESTOS PACKING
See Packing, Asbestos

BALL BEARINGS
See Bearings, Ball

BASES, MOTOR, TENSION ADJUSTING
Alexander Bros., Philadelphia, Pa.
American Pulley Co., Philadelphia, Pa.
Browning Mfg. Co., Inc., Maysville, Ky.
General Electric Co., Schenectady, N. Y.
Ideal Commutator Dresser Co., Sycamore, Ill.
Manley Products Corp., York, Pa.
Rockwood Mfg. Co., Indianapolis, Ind.

BASES AND PADS, VIBRATION ISOLATING
●Armstrong Cork Co., Lancaster, Pa.
●Buffalo Forge Co., Buffalo, N. Y.
Butterworth, B. T., Jr., New Canaan, Conn.
●Clarage Fan Co., Kalamazoo, Mich.
●Cork Import Corp., New York, N. Y.
Cork Insulation Co., Inc., New York, N. Y.
Fabling Co., W. D., Los Angeles, Cal.
●Felters Co., Inc., Boston, Mass.
Firestone Tire & Rubber Co., Akron, O.
Gates Rubber Co., Denver, Col.
Goodrich Co., B. F., Akron, O.
Keldur Corp., New York, N. Y.
Korfund Co., Long Island City, N. Y.
Lord Mfg. Co., Erie, Pa.
Manley Products Corp., York, Pa.
●Mundet Cork Corp., Brooklyn, N. Y.
National Lead Co., New York, N. Y.

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United Cork Companies, Lyndhurst, N. J.
Vibration Eliminator Co., Long Island City, N. Y.
Western Felt Works, Chicago, Ill.

BEARINGS, BALL

Ahlberg Bearing Co., Chicago, Ill.
Bearings Co. of America, Lancaster, Pa.
Dodge Mfg. Corp., Mishawaka, Ind.
Fafnir Bearing Co., New Britain, Conn.
Link-Belt Co., Chicago, Ill.
Marlin-Rockwell, Jamestown, N. Y.
New Departure Div., General Motors Sales Corp., Bristol, Conn.
Norma-Hoffman Bearings Corp., Stamford, Conn.
●SKF Industries, Inc., Philadelphia, Pa.
Schatz Mfg. Co., Fairview, Poughkeepsie, N. Y.
Shafer Bearing Corp., Chicago, Ill.
Stephens-Adamson Mfg. Co., Aurora, Ill.
Wood's Sons Co., T. B., Chambersburg, Pa.

BEARINGS, PILLOW BLOCK

Ahlberg Bearing Co., Chicago, Ill.
●Air Controls, Inc., Cleveland, O.
Caldwell Co., W. E., Louisville, Ky.
Central Die Casting & Mfg. Co., Inc., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Chicago Die Casting Mfg. Co., Chicago, Ill.
Clizbe Bros. Mfg. Co., Plymouth, Ind.
Dodge Mfg. Corp., Mishawaka, Ind.
Fafnir Bearing Co., New Britain, Conn.
Goldens' Foundry & Machine Co., Columbus, Ga.
Hastings Air Conditioning Co., Hastings, Neb.
Jeffrey Mfg. Co., Columbus, O.
Jones Foundry & Machine Co., W. A., Chicago, Ill.
Lau Blower Co., Dayton, O.
Link-Belt Co., Chicago, Ill.
Medart Co., St. Louis, Mo.
●Randall Graphite Products Corp., Chicago, Ill.
Royersford Foundry & Machine Co., Royersford, Pa.
●SKF Industries, Inc., Philadelphia, Pa.
Schwitzer-Cummins Co., Indianapolis, Ind.
Shafer Bearing Corp., Chicago, Ill.
Sprout, Waldron & Co., Muncy, Pa.
Stephens-Adamson Mfg. Co., Aurora, Ill.
Viking Air Conditioning Corp., Cleveland, O.
Wood's Sons Co., T. B., Chambersburg, Pa.

BEARINGS, ROLLER

Dodge Mfg. Corp., Mishawaka, Ind.
Fafnir Bearing Co., New Britain, Conn.
Hyatt Bearings Div., General Motors Sales Corp., Harrison, N. J.
Jones Foundry & Machine Co., W. A., Chicago, Ill.
Link-Belt Co., Chicago, Ill.
Medart Co., St. Louis, Mo.
Norma-Hoffmann Bearings Corp., Stamford, Conn.
Roller Bearing Co. of America, Trenton, N. J.
Royersford Foundry & Machine Co., Royersford, Pa.
●SKF Industries, Inc., Philadelphia, Pa.
Shafer Bearing Corp., Chicago, Ill.
Timken Roller Bearing Co., Canton, O.
Wood's Sons Co., T. B., Chambersburg, Pa.

BEARINGS, SLEEVE

Dodge Mfg. Corp., Mishawaka, Ind.
Federal-Mogul Corp., Detroit, Mich.
Johnson Bronze Co., New Castle, Pa.
Medart Co., St. Louis, Mo.
●Randall Graphite Products Corp., Chicago, Ill.
Wood's Sons Co., T. B., Chambersburg, Pa.

BELLOWS, THERMOSTATIC

●Bishop & Babcock Mfg. Co., Cleveland, O.
Bridgeport Thermostat Co., Bridgeport, Conn.
Cashin Co., W. D., Boston, Mass.
●Clifford Mfg. Co., Boston, Mass.
Cook Electric Co., Chicago, Ill.
●Fulton Sylphon Co., Knoxville, Tenn.

BELTING, FLAT, LEATHER

Alexander Bros., Inc., Philadelphia, Pa.
Chicago Belting Co., Chicago, Ill.
Graton & Knight, Worcester, Mass.
Houghton & Co., E. F., Philadelphia, Pa.
●Rhoads & Sons, J. E., Philadelphia, Pa.
Schieren Co., Chas. A., New York, N. Y.
Williams & Son, I. B., Dover, N. H.

BELTING, FLAT, RUBBER

Boston Woven Hose & Rubber Co., Cambridge, Mass.
Continental Rubber Wks., Erie, Pa.
Dick Co., Inc., R. & J., Passaic, N. J.
Firestone Tire & Rubber Co., Akron, O.
Garlock Packing Co., Palmyra, N. Y.
Gilmer Co., L. H., Philadelphia, Pa.
Goodrich Co., B. F., Akron, O.
Goodyear Tire & Rubber Co., Akron, O.
Hamilton Rubber Mfg. Co., Trenton, N. J.
Jeffrey Mfg. Co., Columbus, O.
Manhattan Rubber Mfg. Co., Div. of Raybestos-Manhattan, Inc., Passaic, N. J.
Republic Rubber Div., Lee Rubber & Tire Corp., Youngstown, O.
Rockwood Mfg. Co., Indianapolis, Ind.
Thermoid Rubber Co., Trenton, N. J.
United States Rubber Co., New York, N. Y.

BELTS, V

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Pulley Co., Philadelphia, Pa.
Browning Mfg. Co., Inc., Maysville, Ky.
Chicago Belting Co., Chicago, Ill.
Continental Rubber Wks., Erie, Pa.
Dayton Rubber Mfg. Co., Dayton, O.
Dick Co., Inc., R. & J., Passaic, N. J.
Gates Rubber Co., Denver, Colo.
Gilmer Co., L. H., Philadelphia, Pa.
Goodrich Co., B. F., Akron, O.
Goodyear Tire & Rubber Co., Akron, O.
Jones Foundry & Machine Co., W. A., Chicago, Ill.
Manhattan Rubber Mfg. Co., Div. of Raybestos-Manhattan, Inc., Passaic, N. J.
Medart Co., St. Louis, Mo.
Republic Rubber Div., Lee Rubber & Tire Corp., Youngstown, O.
Rockwood Mfg. Co., Indianapolis, Ind.
Thermoid Rubber Co., Trenton, N. J.
United States Rubber Co., New York, N. Y.
Wood's Sons Co., T. B., Chambersburg, Pa.
●Worthington Pump & Machinery Corp., Harrison, N. J.

BENDERS, PIPE

American Pipe Bending Machine Co., Inc., Boston, Mass.
American Pipe Tool Co., Chicago, Ill.
Armstrong Mfg. Co., Bridgeport, Conn.
Bernz Co., Inc., Otto, Rochester, N. Y.
Blackhawk Mfg. Co., Milwaukee, Wis.
●Buffalo Forge Co., Buffalo, N. Y.
Crown Die & Tool Co., Chicago, Ill.
Holsclaw Bros., Inc., Evansville, Ind.
Hossfeld Mfg. Co., Winona, Minn.
Jenkins Mfg. Co., New York, N. Y.
Martin & Sons, H. P., Owensboro, Ky.
●Mueller Brass Co., Port Huron, Mich.
National Pipe Bending Co., New Haven, Conn.
Pedrick Tool & Machine Co., Philadelphia, Pa.
Toledo Pipe Threading Machine Co., Toledo, O.
Vanderman Mfg. Co., Willimantic, Conn.
Wallace Supplies Mfg. Co., Chicago, Ill.
●Watson-Stillman Co., Roselle, N. J.

BENDERS, TUBING

American Pipe Bending Machine Co., Inc., Boston, Mass.
Bernz Co., Inc., Otto, Rochester, N. Y.
●Buffalo Forge Co., Buffalo, N. Y.
Hays Mfg. Co., Erie, Pa. (Copper Tube)
Holsclaw Bros., Inc., Evansville, Ind.
Hossfeld Mfg. Co., Winona, Minn.
Imperial Brass Mfg. Co., Chicago, Ill.
Martin & Sons, H. P., Owensboro, Ky.
National Pipe Bending Co., New Haven, Conn.
Parker Appliance Co., Cleveland, O.
Pedrick Tool & Machine Co., Philadelphia, Pa.
Sac Tool Mfg. Co., St. Louis, Mo.
Snap-On Tools Corp., Kenosha, Wis.
●Streamline Pipe & Fittings Div., Mueller Brass Co., Port Huron, Mich.
Wallace Supplies Mfg. Co., Chicago, Ill.

BENDS, EXPANSION, STEAM PIPE

Crane Co., Chicago, Ill.
●Grinnell Co., Inc., Providence, R. I.
Harris & Co., Arthur, Chicago, Ill. (Stainless & non-ferrous)
Harrisburg Steel Corp., Harrisburg, Pa.
Kellogg Co., M. W., The, New York, N. Y. (Corrugated steel)
Limbert & Co., Geo. B., Chicago, Ill.
Lumsden & Van Stone Co., South Boston, Mass.
●Midwest Piping & Supply Co., Inc., St. Louis, Mo.
National Pipe Bending Co., New Haven, Conn.
National Valve & Mfg. Co., Pittsburgh, Pa.
Ohio Pipe Bending & Machine Co., Cleveland, O.
Parks-Cramer Co., Fitchburg, Mass.
Pittsburgh Pipe Coil & Bending Co., Etna, Pa.
Pittsburgh Piping & Equipment Co., Pittsburgh, Pa.
Power Piping Div., Blaw-Knox Co., Pittsburgh, Pa.
Roessing Mfg. Co., Pittsburgh, Pa.
Sales & Co., Murray W., Detroit, Mich.
Shaw Co., Benjamin F., Wilmington, Del.
Shaw-Kendall Engineering Co., Toledo, O.
Walworth Co., New York, N. Y.

BI-METALS, THERMOSTATIC

Chace Valve Co., W. M., Detroit, Mich.
General Plate Co., Attleboro, Mass.
Wilson Co., H. A., The, Newark, N. J.

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BLADES, PROPELLER FAN

●Air Controls, Inc., Cleveland, O.
Aerovent Fan Co., Piqua, O.
Airmaster Corp., Chicago, Ill.
Aire-Foile Fan & Blower Co., Detroit, Mich.
Allen Corp., Detroit, Mich.
●Autovent Fan & Blower Co., Chicago, Ill.
Belanger Fan & Blower Co., Detroit, Mich.
●Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.
Chelsea Fan & Blower Co., New York, N. Y.
Circulators & Devices Mfg. Corp., New York, N. Y.
Dallas Engineering Co., Inc., Dallas, Tex.
DeBothezat Ventilating Equipment Div., American Machine & Metals, Inc., East Moline, Ill.
Economy Electric Mfg. Co., Chicago, Ill.
Electrovent Fan & Mfg. Co., Chicago, Ill.
General Regulator Corp., Chicago, Ill.
International Engrg., Inc., Dayton, O.
Janette Mfg. Co., Chicago, Ill.
Lohman, Inc., Wm. J., New York, N. Y.
Meier Electric & Machine Co., Indianapolis, Ind.
Myers Electric Co., Pittsburgh, Pa.
Norwin Co., Freeport, Ill.
Peerless Electric Co., Warren, O.
Schwitzer-Cummins Co., Indianapolis, Ind.
South Bend Air Products Corp., South Bend, Ind.
●Sturtevant Co., B. F., Hyde Park, Boston, Mass.
●Torrington Mfg. Co., Torrington, Conn.
Utility Fan Corp., Los Angeles, Cal.
Victor Electric Products, Inc., Cincinnati, O.

BLAST HEATERS

See Surface, Heating

BLAST HEATING COILS

See Surface, Heating

BLOWER FANS

See Fans, Centrifugal

BLOWERS, HIGH PRESSURE

For Low Pressure Blower Fans, See Fans, Centrifugal

Allen Billmyre Corp., South Norwalk, Conn.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Blower Corp., Detroit, Mich.
Bayley Blower Co., Milwaukee, Wis.
Beach-Russ Co., New York, N. Y.
●Buffalo Forge Co., Buffalo, N. Y.
Burdett Mfg. Co., Chicago, Ill.
Carling Turbine Blower Co., Worcester, Mass.
Champion Blower & Forge Co., Lancaster, Pa.
●Clarage Fan Co., Kalamazoo, Mich.
De Bothezat Ventilating Equipment Div., American Machine & Metals, Inc., New York, N. Y.
Eclipse Fuel Engineering Co., Rockford, Ill.
Garden City Fan Co., Chicago, Ill.
General Blower Co., Inc., Philadelphia, Pa.
Ingersoll-Rand Co., New York, N. Y.
Kraissl Co., Inc., The, Hackensack, N. J.
Metal Stamping & Mfg. Co., The, Cleveland, O.
Muncie Gear Wks., Muncie, Ind.
North American Mfg. Co., Cleveland, O.
Roots-Connersville Blower Corp., Connersville, Ind.
Spencer Turbine Co., Hartford, Conn.
●Sturtevant Co., B. F., Boston, Mass.
Trimount Rotary Power Co., East Bedham, Mass.
Western Blower Co., Seattle, Wash.
●Wing Mfg. Co., L. J., New York, N. Y.

BLOWERS, SOOT

Bayer Co., St. Louis, Mo.
Diamond Power Specialty Corp., Detroit, Mich.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
Marion Machine Foundry & Supply Co., Marion, Ind.
Perfection Grate & Stoker Co., Springfield, Mass

BLOWER WHEELS

See Wheels, Blower

BLOW-OFF VALVES

See Valves, Blow-Off

BOILER CLEANING COMPOUNDS

See Compounds, Boiler Cleaning

BOILER FEED PUMPS

See Pumps, Boiler Feed

BOILER FEEDERS

See Feeders, Water, Heating Boiler

BOILER SEALING COMPOUNDS

See Compounds, Boiler and Radiator Sealing

BOILER AND TANK INSULATION

See Insulation, Boiler and Tank

BOILER TUBES

See Tubes, Boiler

BOILERS, HEATING, CAST IRON, SECTIONAL

2000 Sq Ft Steam Radiation and Over

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Bryan Steam Corp., Peru, Ind.
Bryant Heater Co., The, Cleveland, O.
●Burnham Boiler Corp., Irvington, N. Y.
Columbia Radiator Co., McKeesport, Pa.
Crane Co., Chicago, Ill.
Eastern Foundry Co., Peerless Heater Div., Boyertown, Pa.
Hart & Crouse Corp., Utica, N. Y.
Herbert Boiler Co., Chicago, Ill.
International Heater Co., Utica, N. Y.
Mueller Furnace Co., L. J., Milwaukee, Wis.
National Radiator Co., The, Johnstown, Pa.
Pierce, Butler Radiator Corp., Syracuse, N. Y.
Prox Co., Inc., Frank, Terre Haute, Ind.
Smith Co., Inc., H. B., The, Westfield, Mass.
Spencer Heater Div., Aviation Mfg. Corp., Williamsport, Pa.
Thatcher Furnace Co., Newark, N. J.
United States Radiator Corp., Detroit, Mich.
Utica Radiator Corp., Utica, N. Y.
Weil-McLain Co., Chicago, Ill.
XXth Century H. & V. Co., Akron, O.

BOILERS, HEATING, STEEL, FIRE TUBE

2000 Sq Ft Steam Radiation and Over

Ames Iron Wks., Div. of Pierce Butler Radiator Corp., Oswego, N. Y.
Bass Foundry & Machine Co., Ft. Wayne, Ind.
Bigelow Co., New Haven, Conn.
Bros Boiler & Mfg. Co., Wm., Minneapolis, Minn.
Brownell Co., Dayton, O.
●Burnham Boiler Corp., Irvington, N. Y.
Cleaver-Brooks Co., Milwaukee, Wis.
Combination Boiler Co., Benton Harbor, Mich.
Combustion Engineering Co., Inc., New York, N. Y.
Dillon Steam Boiler Wks., Inc., D. M., Fitchburg, Mass.
Eclipse Fuel Engineering Co., Rockford, Ill.
Erie City Iron Wks., Erie, Pa.
Farquhar Co., Ltd., A. B., York, Pa.
Farrar & Trefts, Buffalo, N. Y.
Fitzgibbons Boiler Co., Inc., New York, N. Y.
●Frick Co., Waynesboro, Pa.
Frost Mfg. Co., Galesburg, Ill.
Gallaher Boiler Co., St. Louis, Mo.
General Furnaces Corp., New York, N. Y.
Herbert Boiler Co., Chicago, Ill.
Hodge Boiler Wks., East Boston, Mass.
International Boiler Wks. Co., East Stroudsburg, Pa.
International Engineering Wks., Inc., Framingham, Mass.
Johnston Bros., Inc., Ferrysburg, Mich.
Keeler Co., Williamsport, Pa.
●Kewanee Boiler Corp., Kewanee, Ill.
Kisco Boiler & Engineering Co., St. Louis, Mo.
Leffel & Co., Springfield, O.
Lookout Boiler & Mfg. Co., Chattanooga, Tenn.
Manitowoc Boiler Wks., Manitowoc, Wis.
Mears-Kane-Ofeldt, Inc., Philadelphia, Pa.
Milwaukee Reliance Boiler Wks., Milwaukee, Wis.
Murray Iron Wks. Co., Burlington, Ia.
National Radiator Co., The, Johnstown, Pa.
Orr & Sembower, Inc., Reading, Pa.
PS Inc., Los Angeles, Cal. (Flash type)
Pacific Steel Boiler Div., United States Radiator Corp., Detroit, Mich.
Pierce, Butler Radiator Corp., Syracuse, N. Y.
Smith Twin Tubular Boiler Co., Inc., Philadelphia, Pa.
Spencer Heater Div., Aviation Mfg. Corp., Williamsport, Pa.
Titusville Iron Wks. Co., Titusville, Pa.
Union Iron Wks., Erie, Pa.
Vogt Machine Co., Henry, Louisville, Ky.
Vortex Mfg. Co., Portland, Ore.
Waterfilm Boilers, Inc., Jersey City, N. J.
Wickes Boiler Co., Saginaw, Mich.

BOILERS, HEATING, STEEL, WATER TUBE

Babcock & Wilcox Co., New York, N. Y.
Bass Foundry & Machine Co., Ft. Wayne, Ind.
Bros Boiler & Mfg. Co., Wm., Minneapolis, Minn.
Bryan Steam Corp., Peru, Ind.
Combination Boiler Co., Benton Harbor, Mich.
Combustion Engineering Co., Inc., New York, N. Y.
Edge Moor Iron Wks., New York, N. Y.
Erie City Iron Wks., Erie, Pa.
Foster Wheeler Corp., New York, N. Y.
International Boiler Wks. Co., East Stroudsburg, Pa.
International Engineering Wks., Inc., Framingham, Mass.
Keeler Co., E., Williamsport, Pa.
Koven & Bro., Inc., L. O., Jersey City, N. J.
Mears-Kane-Ofeldt, Inc., Philadelphia, Pa.
Murray Iron Wks. Co., Burlington, Ia.
Orr & Sembower, Inc., Reading, Pa.
Riley Stoker Corp., Worcester, Mass.
Smith Twin Tubular Boiler Co., Inc., Philadelphia Pa.
Spencer Heater Div., Aviation Mfg. Corp., Williamsport, Pa.
Titusville Iron Wks. Co., Titusville, Pa.
Union Iron Works, Erie, Pa.
Vapor Car Heating Co., Inc., Chicago, Ill.
Vogt Machine Co., Henry, Louisville, Ky.
Wickes Boiler Co., Saginaw, Mich.

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BOLTS, EXPANSION

Chicago Expansion Bolt Co., Chicago, Ill.
Diamond Expansion Bolt Co., Garwood, N. J.
Fee & Mason Mg. Co., Inc., New York, N. Y.
Multi-Seal Mfg. Co., Chicago, Ill.
National Lead Co., New York, N. Y.
Paine Co., Chicago, Ill.
Rawlplug Co., Inc., The, New York, N. Y.
Star Expansion Bolt Co., New York, N. Y.
U. S. Expansion Bolt Co., York, Pa.

BOLTS AND STUDS, FLANGE

Bethlehem Steel Co., Bethlehem, Pa.
Clark Bros. Bolt Co., Milldale, Conn.
Crane Co., Chicago, Ill.
Erie Bolt & Nut Co., Erie, Pa.
Haskell Mfg. Co., Wm. H., Pawtucket, R. I.
Lamson & Sessions Co., Cleveland, O.
Maintenance Engineering Corp., Houston, Texas
Multi-Seal Mfg. Co., Chicago, Ill.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.

BOLTS, TOGGLE AND ANCHOR

Carty & Moore Engineering Co., Detroit, Mich.
Chicago Expansion Bolt Co., Chicago, Ill.
Diamond Expansion Bolt Co., Garwood, N. J.
Fee & Mason Mfg. Co., Inc., New York, N. Y.
Grabler Mfg. Co., Cleveland, O.
Lamson & Sessions Co., Cleveland, O.
Multi-Seal Mfg. Co., Chicago, Ill.
Paine Co., Chicago, Ill.
Rawlplug Co., Inc., The, New York, N. Y.
Star Expansion Bolt Co., New York, N. Y.
U. S. Expansion Bolt Co., York, Pa.

BRAKES, SHEET METAL

Bath & Co., Cyril, Cleveland, O.
Bertsch & Co., Cambridge City, Ind.
Cincinnati Shaper Co., Cincinnati, O.
Dreis & Krump Mfg. Co., Chicago, Ill.
Eiker Mfg. Co., Ogallala, Nebr.
Excelsior Tool & Machine Co., East St. Louis, Ill.
Harris, A. R., Hammond, Ind.
Heartley Machine & Tool Co., Toledo, O.
New Albany Machine Mfg. Co., New Albany, Ind.
Niagara Machine & Tool Wks., Buffalo, N. Y.
Ohl & Son, George A., Newark, N. J.
Peck, Stow & Wilcox Co., Southington, Conn.
Rafter Machine Co., Belleville, N. J.
Verson Allsteel Press Co., Chicago, Ill.
● Whitney Metal Tool Co., Rockford, Ill.

BRASS PIPE

See Pipe, Brass and Copper

BRASS TUBING

See Tubing, Brass and Copper

BRASS UNIONS

See Unions, Brass

BRASS VALVES

See Valves, Gate; and Valves, Globe

BRAZING TORCHES

See Torches, Brazing

BRONZE VALVES

See Valves, Gate; and Valves, Globe

BUILDING INSULATION

See Insulation, Building

BURNERS, GAS, COMMERCIAL AND INDUSTRIAL

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Babcock & Wilcox Co., New York, N. Y.
Barber Gas Burner Co., Cleveland, O.
Bryant Heater Co., The, Cleveland, O.
Burdett Mfg. Co., Chicago, Ill.
Campbell Heating Co., E. K., Kansas City, Mo.
Continental Stove Corp., Ironton, O.
Coppus Engineering Corp., Worcester, Mass.
Eclipse Fuel Engrg. Co., Rockford, Ill.
Engineer Co., New York, N. Y.
Enterprise Oil Burner Co., San Francisco, Cal.
Hugo Mfg. Co., West Duluth, Minn.
Lammert & Mann Co., Chicago, Ill.
Martin, J. O. & C. U., San Francisco, Cal.
Mears-Kane-Ofeldt, Inc., Philadelphia, Pa.
Mettler Co., Lee B., Los Angeles, Cal.
National Machine Wks., Chicago, Ill.
North American Mfg. Co., Cleveland, O.
Payne Furnace & Supply Co., Inc., Beverly Hills, Cal.
Peabody Engrg. Corp., New York, N. Y.
R-S Products Corp., Philadelphia, Pa.
Ray Oil Burner Co., San Francisco, Cal.
Reznor Mfg. Co., Mercer, Pa.
Roberts-Gordon Appliance Corp., Buffalo, N. Y.
Rotary Mfg. Co., Los Angeles, Cal.
Schutte & Koerting Co., Philadelphia, Pa.
Staples & Pfeiffer, Ltd., San Francisco, Cal.
Surface Combustion Corp., Toledo, O.
● Webster Engineering Co., Tulsa, Okla.
Williams, Inc., F. C., Dearborn, Mich.
Zink Co., John, Tulsa, Okla.

BURNERS, OIL, COMMERCIAL AND INDUSTRIAL

Ace Engineering Co., Chicago, Ill.
American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Babcock & Wilcox Co., New York, N. Y.
Bennett Co., Omaha, Nebr.
Bethlehem Foundry & Machine Co., Bethlehem, Pa.
Caloroil Burner Corp., Hartford, Conn.
Century Engrg. Corp., Cedar Rapids, Ia.
Chalmers Oil Burner Co., Minneapolis, Minn.
Chisholm Co., Allen E., Portland, Ore.
Cleaver-Brooks Co., Milwaukee, Wis.
Combustion Engineering Co., Inc., New York, N. Y.
Connery Construction Co., Philadelphia, Pa.
d'Este Co., Julian, Charlestown, Mass.
Electrol, Inc., Clifton, N. J.
Engineering Co., New York, N. Y.
Enterprise Oil Burner Co., San Francisco, Cal.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Hardinge Mfg. & Oil Burner Co., Chicago, Ill.
Holtum Mfg. Co., Freeport, Ill.
Johnson Co., S. T., Oakland, Cal.
Johnson Mfg. Co., Waterloo, Ia.
Kisco Boiler & Engineering Co., St. Louis, Mo.
Lammert & Mann Co., Chicago, Ill.
Littleford Bros., Cincinnati, O.
Mettler Co., Lee B., Los Angeles, Cal.
Micro-Westco, Inc., Bettendorf, Ia.
Milwaukee Reliance Boiler Wks., Milwaukee, Wis.
Monarch Mfg. Works., Inc., Philadelphia, Pa.
National Airoil Burner Co., Inc., Philadelpia, Pa.
North American Mfg. Co., Cleveland, O.
Nu-Way Corp., Rock Island, Ill.
Peabody Engrg. Corp., New York, N. Y.
Petroleum Heat & Power Co., Stamford, Conn.
R-S Products Corp., Philadelphia, Pa.
Ray Oil Burner Co., San Francisco, Cal.
Reif-Rexoil, Inc., Buffalo, N. Y.
Riley Stoker Corp., Worcester, Mass.
Rotary Mfg. Co., Los Angeles, Cal.
Schutte & Koerting Co., Philadelphia, Pa.
Simplex Oil Heating Corp., New York, N. Y.
Staples & Pfeiffer, Ltd., San Francisco, Cal.
Todd Combustion Equipment, Inc., Brooklyn, N. Y.
Vortex Mfg. Co., Portland, Ore.
Wayne Oil Burner Corp., Fort Wayne, Ind.
● Webster Engineering Co., Tulsa, Okla.
Williams Oil-O-Matic Heating Corp., Bloomington, Ill.
York Oil Burner Co., Inc., York, Pa.
Zink Co., John, Tulsa, Okla.

CARBON DIOXIDE ANALYZERS

See Analyzers, Carbon Dioxide, Portable

CARBON DIOXIDE INDICATORS

See Indicators, Carbon Dioxide, Boiler Room

CAST IRON PIPE

See Pipe, Cast Iron

CEMENT AND COMPOUNDS, PIPE JOINT

Acme Refining Co., The, Cleveland, O.
Acorn Refining Co., Cleveland, O.
Akron Metallic Gasket Co., Akron, O.
Atlas Chemical Co., Marietta, O.
Barber Asphalt Corp., Barber, N. J.
● Bell & Gossett Co., Chicago, Ill.
Blue Seal Chemical Co., Roselle Park, N. J.
Burnley Battery & Mfg. Co., North East, Pa.
Cabot, Inc., Samuel, Boston, Mass.
Calbar Paint & Varnish Co., Philadelphia, Pa.
Clinton Metallic Paint Co., Clinton, N. Y.
Colebrook & Sons, Inc., W. H., Syracuse, N. Y.
Continental Products Co., Euclid, O.
Cooper Sanitary Co., Philadelphia, Pa.
Crane Co., Chicago, Ill.
Croll & Son, Jesse G., Philadelphia, Pa.
Desolvo Mfg. Co., Pittsburgh, Pa.
Detroit Graphite Co., Detroit, Mich.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.
● Grinnell Co., Inc., Providence, R. I.
Hercules Chemical Co., Inc., New York, N. Y.
Hilo Varnish Corp., Brooklyn, N. Y.
Horn Co., A. C., Long Island City, N. Y.
Key Co., East St. Louis, Ill.
Mackson's Co., New York, N. Y.
Metropolitan Refining Co., Inc., Long Island City, N. Y.
National Engineering Products, Inc., Washington, D. C.
Preferred Utilities Mfg. Corp., New York, N. Y.
Permatex Co., Inc., Sheepshead Bay, N. Y.
Pyrolite Products Co., Cleveland, O.
Radiator Specialty Co., Charlotte, N. C.
● Ric-wiL Co., Cleveland, O.
Rockwood Sprinkler Co., Worcester, Mass.
Sauereisen Cements Co., Sharpsburg, Pa.
Schundler & Co., F. E., Long Island City, N. Y.
Smooth-On Mfg. Co., Jersey City, N. J.

● Advertisement in this issue. See Index to Advertisers, page 208.

Star Products Co., New York, N. Y.
Superior Valve & Fittings Co., Pittsburgh, Pa.
U. S. Stonewear Co., New York, N. Y.
X-Pando Corp., Long Island City, N. Y.

CEMENT, INSULATING

Acme Asbestos Covering & Flooring Co., Chicago, Ill.
Baldwin-Hill Co., Trenton, N. J. (Rock wool)
●Carey Co., Philip, Lockland, Cincinnati, O.
Chicago Fire Brick Co., Chicago, Ill.
Clinton Metallic Paint Co., Clinton, N. Y.
Colebrook & Sons, Inc., W. H., Syracuse, N. Y.
Eagle-Picher Lead Co., Cincinnati, O.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
General Insulating & Mfg. Co., St. Louis, Mo.
Industrial Research, Lansdowne, Pa.
International Vermiculite Co., Springfield, Ill.
Johns-Manville, New York, N. Y.
Keasbey Co., Robert A., New York, N. Y.
Keasbey & Mattison Co., Ambler, Pa.
Krehbiel, J. H., Chicago, Ill. (Asbestos, mineral wool)
McLeod & Henry Co., Troy, N. Y.
Minfelt Insulation Co., The, Toledo, O.
Norristown Magnesia & Asbestos Co., Norristown, Pa.
National Engineering Products Inc., Washington, D. C.
●Owens-Corning Fiberglas Corp., Toledo, O.
Pecora Paint Co., Philadelphia, Pa. (Asbestos furnace cement)
Pyrolite Products Co., Cleveland, O.
Ramtite Co., The, Chicago, Ill.
Refractory & Insulation Corp., New York, N. Y.
Ruberoid Co., New York, N. Y.
Sall Mountain Co., Chicago, Ill.
Schundler & Co., Inc., F. E., Long Island City, N. Y.
Smith & Kanzler, Inc., Elizabeth, N. J.
Standard Asbestos Mfg. Co., Chicago, Ill.
Standard Lime & Stone Co., Baltimore, Md.
Therminsul Corp., Kalamazoo, Mich.
Thompson & Co., Pittsburgh, Pa.
United States Gypsum Co., Chicago, Ill.
United States Mineral Wool Co., Chicago, Ill.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
●Wilson, Inc., Grant, Chicago, Ill.

CENTRIFUGAL PUMPS

See Pumps, Centrifugal

CHAIN DRIVES

See Drives, Chain

CHANGERS, SPEED, HYDRAULIC COUPLING

American Blower Corp., Detroit, Mich.
●U. S. Air Conditioning Corp., Minneapolis, Minn.

CHANGERS, SPEED, MECHANICAL

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Dodge Mfg. Corp., Mishawaka, Ind.
Link-Belt Co., Chicago, Ill.
Stephens-Adamson Mfg. Co., Aurora, Ill.

CHECK VALVES

See Valves, Check

CHILLERS, WATER, FOR AIR CONDITIONING AND REFRIGERATION

Acme Industries, Inc., Jackson, Mich.
●Baker Ice Machine Co., Inc., Omaha, Neb.
Croll-Reynolds Engineering Co., Inc., New York, N. Y.
Drayer & Hanson, Inc., Los Angeles, Cal.
Filtrine Mfg. Co., Brooklyn, N. Y.
●Frick Co., Waynesboro, Pa.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
Griscom-Russell Co., The, New York, N. Y.
Howe Ice Machine Co., Chicago, Ill.
●McQuay, Inc., Minneapolis, Minn.
Mojonnier Bros. Co., Chicago, Ill.
●Patterson-Kelley Co., Inc., East Stroudsburg, Pa.
Refrigeration Economics Co., Inc., Canton, O.
Richmond Engineering Co., Inc., Richmond, Va.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Sims Co., Erie, Pa.
Taco Heaters, Inc., New York, N. Y.
●Vilter Mfg. Co., Milwaukee, Wis.
Whitehead Metal Products Co. of New York, Inc., New York, N. Y.
Whitlock Coil Pipe Co., Hartford, Conn.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
XL Refrigerating Co., Chicago, Ill.
●York Ice Machinery Corp., York, Pa.

CIRCULATORS FOR HOT WATER HEATING SYSTEMS

Atlantic Valve & Pump Co., Chicago, Ill.
●Bell & Gossett Co., Chicago, Ill.
Columbus Steam Pump Works Co., Columbus, O.
Economy Pumps, Inc., Chicago, Ill.
Everite Pump & Mfg. Co., Inc., Lancaster, Pa.
Frederick Iron & Steel Co., Frederick, Md.
General Blower Co., Inc., Philadelphia, Pa.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Hoffman Specialty Co., Inc., Waterbury, Conn.
Hotstream Heater Co., Cleveland, O.
Kehm Corp., The, Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Penberthy Injector Co., Detroit, Mich.
Sterling Engineering Co., Milwaukee, Wis.
Taco Heaters, Inc., New York, N. Y.
Thrush & Co., H. A., Peru, Ind.
Triplex Mfg. Co., Peru, Ind.
Watts Regulator Co., Lawrence, Mass.
Weil Pump Co., Chicago, Ill.
White Flo-Matic Corp., Hoosick Falls, N. Y.
Yeomans Bros. Co., Chicago, Ill.

CLAMPS, BEAM, PIPE HANGING

Beaton & Cadwell Mfg. Co., New Britain, Conn.
Carpenter & Paterson, Inc., East Boston, Mass.
Chicago Nipple Mfg. Co., Chicago, Ill.
Crawford Co., Chicago, Ill.
Farley Sleeve & Hanger Co., Cleveland, O.
Fee & Mason Mfg. Co., Inc., New York, N. Y.
Globe Machine & Stamping Co., Cleveland, O.
Grabler Mfg. Co., Cleveland, O.
●Grinnell Co., Inc., Providence, R. I.
Jarecki Mfg. Co., Erie, Pa.
Limbert & Co., Geo. B., Chicago, Ill.
National Valve & Mfg. Co., Pittsburgh, Pa.
Paine Co., Chicago, Ill.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Rockwood Sprinkler Co., Worcester, Mass.
Walworth Co., New York, N. Y.

CLAMPS, PIPE REPAIR

Chelsea Metal Stamping Co., New York, N. Y.
Dresser Mfg. Co., Bradford, Pa.
Inner-Tite Clamp Corp., Elizabeth, N. J.
Jarecki Mfg. Co., Erie, Pa.
Skinner Co., M. B., South Bend, Ind.

CLAMPS, PIPE, WELDING

●Jewel Mfg. Co., St. Paul, Minn.
Smooth-On Mfg. Co., Jersey City, N. J.

CLEANERS, AIR, ELECTRICAL

●American Air Filter Co., Inc., Louisville, Ky.
Pangborn Corp., Hagerstown, Md.
●Westinghouse Electric & Mfg. Co., Cleveland, O.

CLEANERS, TUBE

Elliott Co., Jeannette, Pa.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
Perfection Grate & Stoker Co., Springfield, Mass.
Pierce Co., Wm. B., Buffalo, N. Y.
Pilley Packing & Flue Brush Co., St. Louis, Mo.
Spencer Turbine Co., Hartford, Conn.

COILS

See Surface, Cooling; Surface, Heating

COLLECTORS, DUST

●Airtherm Mfg. Co., St. Louis, Mo.
Allen Billmyre Corp., South Norwalk, Conn.
●American Air Filter Co., Louisville, Ky.
American Blower Corp., Detroit, Mich.
American Foundry Equipment Co., Mishawaka, Ind.
Bayley Blower Co., Milwaukee, Wis.
Belanger Fan & Blower Co., Detroit, Mich.
Blower Application Co., Milwaukee, Wis.
Bubar, Hudson H., New York, N. Y.
●Buffalo Forge Co., Buffalo, N. Y.
Clark Dust Control Co., Chicago, Ill.
Day Co., The, Minneapolis, Minn.
Dracco Corp., Cleveland, O.
Falstrom Co., Passaic, N. J.
Garden City Fan Co., Chicago, Ill.
Goethel Co., Alfred C., Milwaukee, Wis.
Goethel Sheet Metal Wks., Alfred, Milwaukee, Wis.
Grand Rapids Blow Pipe & Dust Arrester Co., Grand Rapids, Mich.
Industrial Sheet Metal Wks., Inc., Detroit, Mich.
Jacobs Co., B. & J., Cincinnati, O.
Kirk & Blum Mfg. Co., Cincinnati, O.
Knickerbocker Co., Jackson, Mich.
Martin Metal Mfg. Co., Wichita, Kan.
New York Blower Co., Chicago, Ill.
Northern Blower Co., Cleveland, O.
Pangborn Corp., Hagerstown, Md.
Prat-Daniel Corp., Port Chester, N. Y.
Puhl & Hepper Mfg. Co., Inc., St. Louis, Mo.
Research Corp., New York, N. Y.
Ruemelin Mfg. Co., Milwaukee, Wis.
●St. Louis Blow Pipe & Heater Co., St. Louis, Mo.
Schneible Co., Claude B., Chicago, Ill.
Sly Mfg. Co., W. W., Cleveland, O.
Spencer Turbine Co., Hartford, Conn.
Sprout, Waldron & Co., Muncy, Pa.
Steamaire Co., Cincinnati, O.
●Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Sturtevant Mill Co., Boston, Mass.
Western Blower Co., Seattle, Wash.
Western Precipitation Corp., Los Angeles, Cal.
Young & Bertke Co., Cincinnati, O.

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COLLECTORS, WELDING FUME

Lincoln Electric Co., Cleveland, O.
Ruemelin Mfg. Co., Milwaukee, Wis.

COMBUSTION CONTROL

See Regulators, Draft, Combustion

COMBUSTION CONTROL SYSTEMS

See Systems, Combustion Control

COMBUSTION RECORDERS

See Recorders, Carbon Dioxide

COMPOUNDS, BOILER CLEANING

Acme Refining Co., The, Cleveland, O.
American Teksag Products, Inc., Mount Vernon, N. Y.
Aquatic Chemical Laboratories, Inc., New York, N. Y.
Blue Seal Chemical Co., Roselle Park, N. J.
Chicago Specialty Mfg. Co., Chicago, Ill.
Continental Products Co., Euclid, O.
Dissolene Corp., Hempstead, N. Y.
Ferro-Nil Corp., New York, N. Y.
Grief, Edward C., Bogota, N. J.
Haering & Co., Inc., D. W., Chicago, Ill.
Hercules Chemical Co., Inc., New York, N. Y.
Metropolitan Refining Co., Inc., Long Island City, N. Y.
Mouat Vapor Heating Co., The, Cleveland, O.
Radiator Specialty Co., Charlotte, N. C.
Star Products Co., New York, N. Y.
Vinco Co., Inc., The, New York, N. Y.
X Laboratories, Inc., New York, N. Y.

COMPOUNDS, BOILER AND RADIATOR SEALING

Atlas Chemical Co., Marietta, O.
Blue Seal Chemical Co., Roselle Park, N. J.
Chicago Specialty Mfg. Co., Chicago, Ill.
Cooper Sanitary Co., Philadelphia, Pa.
Desolvo Mfg. Co., Pittsburgh, Pa.
●Dole Valve Co., Chicago, Ill.
Hercules Chemical Co., Inc., New York, N. Y.
Metropolitan Refining Co., Inc., Long Island City, N. Y.
National Engineering Products, Inc., Washington, D. C.
Permatex Co., Inc., Sheepshead Bay, N. Y.
Radiator Specialty Co., Charlotte, N. C.
Star Products Co., New York, N. Y.
Vinco Co., Inc., The, New York, N. Y.
X Laboratories, Inc., New York, N. Y.

COMPOUNDS, CAULKING

Accurate Metal Weather Strip Co., New York, N. Y.
Acme Refining Co., The, Cleveland, O.
All Metal Weatherstrip Co., Chicago, Ill.
American Metal Weather Strip Co., Grand Rapids, Mich.
Armstrong Co., The, Detroit, Mich.
Barber Asphalt Corp., Barber, N. J.
Barland Weatherstrip Material Co., Cleveland, O.
Calbar Paint & Varnish Co., Philadelphia, Pa.
●Carey Co., Philip, Cincinnati, O.
Chamberlin Metal Weather Strip Co., Detroit, Mich.
Clinton Metallic Paint Co., Clinton, N. Y.
Continental Products Co., Euclid, O.
Diamond Metal Weather Strip Co., Columbus, O.
Hetzel Roofing Products Co., Newark, N. J.
Horn Co., A. C., Long Island City, N. Y.
Iowa Paint Mfg. Co., Des Moines, Ia.
Johns-Manville, New York, N. Y.
Krehbiel, J. H., Chicago, Ill.
Lastik Products Co., Inc., Pittsburgh, Pa.
Metropolitan Refining Co., Inc., Long Island City, N. Y.
National Mfg. Corp., Tonawanda, N. Y.
Ohmiac Paint & Refining Co., Chicago, Ill.
Pecora Paint Co., Philadelphia, Pa.
Plastic Products Co., Detroit, Mich.
Pyrolite Products Co., Cleveland, O.
Radiator Specialty Co., Charlotte, N. C.
Reilly Tar & Chemical Corp., Indianapolis, Ind.
Robertson Co., H. H., Pittsburgh, Pa.
Sauereisen Cements Co., Sharpsburg, Pa.
Smooth-On Mfg. Co., Jersey City, N. J.
Thompson & Co., Pittsburgh, Pa.
Wilhelm Co., A., Reading, Pa.
X-Pando Corp., Long Island City, N. Y.
Yardley Screen & Weather Strip Corp., Columbus, O.

COMPRESSOR BASES

See Bases and Pads, Vibration Isolating

COMPRESSORS, AIR

Allen Billmyre Corp., South Norwalk, Conn.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Binks Mfg. Co., Chicago, Ill.
Brunner Mfg. Co., Utica, N. Y.
Bury Compressor Co., Erie, Pa.
Chicago Pneumatic Tool Co., New York, N. Y.
●Curtis Refrigerating Machine Co., St. Louis, Mo.
Dayton Air Compressor Co., Dayton, O.
DeVilbiss Co., The, Toledo, O.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.
Fuller Co., Catasauqua, Pa.
Gardner-Denver Co., Quincy, Ill.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Hobart Bros., Troy, O.
Ingersoll-Rand, New York, N. Y.
Janette Mfg. Co., Chicago, Ill.
Kraissl Co., Inc., The, Hackensack, N. J.
Lammert & Mann Co., Chicago, Ill.
●Nash Engineering Co., South Norwalk, Conn.
Pennsylvania Pump & Compressor Co., Easton, Pa.
Plummer Spray Equipment Co., Napoleon, O.
Schramm, Inc., West Chester, Pa.
Spencer Turbine Co., Hartford, Conn.
●Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Trimount Rotary Power Co., East Dedham, Mass.
●Worthington Pump & Machinery Corp., Harrison, N. J.
Yeomans Bros. Co., Chicago, Ill.

COMPRESSORS, REFRIGERATING, CENTRIFUGAL

●Carrier Corp., Syracuse, N. Y. (Carrene)
DeLaval Steam Turbine Co., Trenton, N. J. (Water vapor).
Ingersoll-Rand, New York, N. Y. (Water vapor).
●Trane Co., LaCrosse, Wis.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.

COMPRESSORS, REFRIGERATING, RECIPROCATING

Airtemp, Div. of Chrysler Corp., Dayton, O. (Radial).
●Baker Ice Machine Co., Inc., Omaha, Nebr. ("Freon," Methyl chloride, Ammonia).
Brunner Mfg. Co., Utica, N. Y. (Methyl chloride, "Freon," sulphur dioxide).
●Carrier Corp., Syracuse, N. Y. (Ammonia, "Freon," methyl chloride, carbon dioxide).
Copeland Refrigeration Corp., Sidney, O.
Corozone Air Conditioning Corp., Cleveland, O.
●Curtis Refrigerating Machine Co., St. Louis, Mo.
De La Vergne Engine Co., Philadelphia, Pa. (Ammonia, "Freon").
Fairbanks, Morse & Co., Chicago, Ill.
●Frick Co., Waynesboro, Pa. (Ammonia, carbon dioxide, methyl chloride, "Freon").
Frigidaire Commercial & Air Conditioning Div., General Motors Sales Corp., Dayton, O.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
General Machinery Co., Spokane, Wash.
General Refrigeration Corp., Beloit, Wis.
Hardy Mfg. Co. Inc., Dayton, O. (Sulphur dioxide, methyl chloride).
Howe Ice Machine Co., Chicago, Ill. ("Freon," ammonia. methyl chloride).
Kauffman Air Conditioning Corp., St. Louis, Mo.
Kelvinator Div., Nash-Kelvinator Corp., Detroit, Mich.
Merchant & Evans Co., Philadelphia, Pa. ("Freon," methyl chloride, sulphur dioxide).
Mills Novelty Co., Chicago, Ill.
Modern Equipment Corp., Defiance, O.
Nash Refrigeration Co., Inc., Newark, N. J.
Norge Div., Borg-Warner Corp., Detroit, Mich.
Phoenix Ice Machine Co., Cleveland, O.
Reliance Refrigerating Machine Co., Chicago, Ill. ("Freon," methyl chloride, ammonia).
Servel, Inc., Electric Refrigeration & Air Conditioning Div., Evansville, Ind. ("Freon," methyl chloride).
Starr Piano Co., Richmond, Ind.
Stewart Ice Machine Co., Los Angeles, Cal.
Tecumseh Products Co., Tecumseh, Mich.
●Trane Co., La Crosse, Wis.
Triumph Ice Machine Co., Cincinnati, O. (Ammonia).
Uniflow Mfg. Co., Erie, Pa. (Sulphur dioxide, methyl chloride).
●Universal Cooler Corp., Detroit, Mich. (Methyl chloride, "Freon").
●Vilter Mfg. Co., Milwaukee, Wis. ("Freon," ammonia).
●Westinghouse Electric & Mfg. Co., East Springfield, Mass.
Williams Oil-O-Matic Heating Corp., Bloomington, Ill. ("Freon," methyl chloride).
Wittenmeier Machinery Co., Chicago, Ill. (Carbon dioxide).
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
XL Refrigerating Co., Chicago, Ill. (Ammonia, methyl chloride).
●York Ice Machinery Corp., York, Pa. (Carbon dioxide, ammonia, "Freon").

COMPRESSORS, REFRIGERATING, STEAM JET

●Carrier Corp., Syracuse, N. Y.
Croll-Reynolds Engrg. Co., Inc., New York, N. Y.
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., New York, N. Y.
Ingersoll-Rand, New York, N. Y.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Wheeler Mfg. Co., C. H., Philadelphia, Pa.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.

COMPRESSORS, STEAM BOOSTER

Pennsylvania Pump & Compressor Co., Easton, Pa.
●Worthington Pump & Machinery Corp., Harrison, N. J.

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CONDENSATION METERS

See Meters, Condensation

CONDENSATION PUMPS

See Pumps, Condensation

CONDENSERS, REFRIGERATING, EVAPORATIVE

Acme Industries, Inc., Jackson, Mich.
●Baker Ice Machine Co., Inc., Omaha, Nebr.
●Buffalo Forge Co., Buffalo, N. Y.
●Carrier Corp., Syracuse, N. Y.
●Curtis Refrigerating Machine Co., St. Louis, Mo.
Drayer & Hanson, Inc., Los Angeles, Cal.
●Frick Co., Waynesboro, Pa.
Frigidaire Commercial & Air Conditioning Div., General Motors Sales Corp., Dayton, O.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
General Refrigeration Corp., Beloit, Wis.
●Hess Warming & Ventilating Co., Chicago, Ill.
Kelvinator Div., Nash-Kelvinator Corp., Detroit, Mich.
Kramer Trenton Co., Trenton, N. J.
Larkin Coils, Inc., Atlanta, Ga.
Long Mfg. Co., Div. Borg-Warner Corp., Detroit, Mich.
●McQuay, Inc., Minneapolis, Minn.
Motor Equipment Co., Wichita, Kans.
Norge Div., Borg-Warner Corp., Detroit, Mich.
Peerless of America., Inc., Chicago, Ill.
Refrigeration Economics Co., Inc., Canton, O.
Research Corp., New York, N. Y.
Richmond Engrg. Co., Inc., Richmond, Va.
●Trane Co., La Crosse, Wis.
●Vilter Mfg. Co., Milwaukee, Wis.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
XL Refrigerating Co., Chicago, Ill.
Yates-American Machine Co., Beloit, Wis.
●York Ice Machinery Corp., York, Pa.
●Young Radiator Co., Racine, Wis.

CONDENSERS, REFRIGERATING, SHELL AND TUBE

Acme Industries, Inc., Jackson, Mich.
Advanced Refrigerating Systems Co., Philadelphia, Pa.
●Baker Ice Machine Co., Inc., Omaha, Nebr.
Bush Mfg. Co., Hartford, Conn.
●Carrier Corp., Syracuse, N. Y. (Carrene).
De La Vergne Engine Co., Philadelphia, Pa.
Devine Mfg. Co., Inc., J. P., Mt. Vernon, Ill.
Drayer & Hanson, Inc., Los Angeles, Cal.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.
●Frick Co., Waynesboro, Pa.
Frigidaire Commercial & Air Conditioning Div., General Motors Sales Corp., Dayton, O.
●G. & O. Mfg. Co., New Haven, Conn.
General Refrigeration Corp., Beloit, Wis.
Harrison Radiator Div., Lockport, N. Y.
Howe Ice Machine Co., Chicago, Ill.
Kelvinator Div., Nash-Kelvinator Corp., Detroit, Mich.
Kramer Trenton Co., Trenton, N. J.
Manufacturers Fin Coil Co., Chicago, Ill.
Nash Refrigeration Co., Inc., Newark, N. J.
Norge Div., Borg-Warner Corp., Detroit, Mich.
Ohio Pipe Bending & Machine Co., Cleveland, O.
●Patterson-Kelley Co., Inc., East Stroudsburg, Pa.
Refrigeration Economics Co., Inc., Canton, O.
Reliance Refrigerating Machine Co., Chicago, Ill.
Richmond Engrg. Co., Inc., Richmond, Va.
Roessing Mfg. Co., Pittsburgh, Pa.
Rome-Turney Radiator Co., Rome, N. Y.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Servel, Inc., Electric Refrigeration & Air Conditioning Div., Evansville, Ind.
Stewart Ice Machine Co., Los Angeles, Cal.
Struthers-Wells-Titusville Co., Warren, Pa.
Triumph Ice Machine Co., Cincinnati, O. (Ammonia).
●Unit Heater & Cooler Co., Wausau, Wis.
●Vilter Mfg. Co., Milwaukee, Wis.
Vogt Machine Co., Henry, Louisville, Ky.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Wittenmeier Machinery Co., Chicago, Ill.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
XL Refrigerating Co., Chicago, Ill.
●York Ice Machinery Corp., York, Pa.
●Young Radiator Co., Racine, Wis.

CONDENSING UNITS

See Compressors

CONDUIT, UNDERGROUND PIPING

●American District Steam Co., North Tonawanda, N. Y.
Dockstader, S. E., Washington, D. C.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Johns-Manville, New York, N. Y.
●Porter & Co., Inc., H. W., Newark, N. J.
●Ric-wiL Co., Cleveland, O.
Underground Steam Construction Co., Boston, Mass.
Wyckoff & Son Co., A., Elmira, N. Y.

CONNECTIONS, DUCT, FLEXIBLE (ASBESTOS, CANVAS, ETC.)

Canvas Products Co., St. Louis, Mo.
Carpenter & Co., Geo. B., Chicago, Ill.
●Wilson, Inc., Grant, Chicago, Ill. (Asbestos).

CONTROLLERS AND STARTERS, MOTOR

●Allen-Bradley Co., Milwaukee, Wis.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Arrow-Hart & Hegeman Elec. Co., Hartford, Conn.
Clark Controller Co., Cleveland, O.
Cutler-Hammer, Inc., Milwaukee, Wis.
Electric Controller & Mfg. Co., Cleveland, O.
Electric Machinery Co., Minneapolis, Minn. (Synchronous motor).
General Electric Co., Schenectady, N. Y.
Hart Mfg. Co., Hartford, Conn.
Monitor Controller Co., Baltimore, Md.
Penn Electric Switch Co., Goshen, Ind.
Reynolds Electric Co., Chicago, Ill.
Square D Co., Milwaukee, Wis.
●Ward Leonard Electric Co., Mt. Vernon, N. Y.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CONTROLS, SPRINKLER SYSTEM

American District Telegraph Co., New York, N. Y.
●Grinnell Co., Inc., Providence, R. I.
Rockwood Sprinkler Co., Worcester, Mass.
Square D Co., Detroit, Mich.

CONVECTORS

See Radiation, Convection Type

COOLERS, UNIT (FLOOR TYPE)

Not air conditioning units, but floor mounted unit with coil and centrifugal fans without filters, for connection to remote compressor or cold water supply. For air conditioning units see Units, Air Conditioning

Acme Industries, Inc., Jackson, Mich.
Air Devices Corp., Meriden, Conn.
American Blower Corp., Detroit, Mich.
●Baker Ice Machine Co., Inc., Omaha, Neb.
Ballantyne Co., Omaha, Neb.
Betz Air Conditioning Corp., Kansas City, Mo.
●Buffalo Forge Co., Buffalo, N. Y.
●Carrier Corp., Syracuse, N. Y.
●Clarage Fan Co., Kalamazoo, Mich.
Conditionaire Unit Co., Chicago, Ill.
Coolmaster Corp., Chicago, Ill. (Evaporative cooling principle, no dehumidifying)
●Curtis Refrigerating Machine Co., St. Louis, Mo.
Drayer & Hanson, Inc., Los Angeles, Cal.
Economy Equipment Co., Chicago, Ill.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.
●Frick Co., Waynesboro, Pa.
General Refrigeration Corp., Beloit, Wis.
Hastings Air Conditioning Co., Hastings, Neb.
Howe Ice Machine Co., Chicago, Ill.
●Industrial Mfg. & Engineering Co., Chicago, Ill.
Kauffman Air Conditioning Corp., St. Louis, Mo.
Kramer Trenton Co., Trenton, N. J.
●McQuay, Inc., Minneapolis, Minn.
Norge Div., Borg-Warner Corp., Detroit, Mich.
Peerless of America, Inc., Chicago, Ill.
Refrigeration Appliances, Inc., Chicago, Ill.
Refrigeration Economics Co., Inc., Canton, O.
●Rempe Co., Chicago, Ill.
Richmond Engineering Co., Inc., Richmond, Va.
●St. Louis Blow Pipe & Heater Co., St. Louis, Mo.
●Trane Co., LaCrosse, Wis.
●U. S. Air Conditioning Corp., Minneapolis, Minn.
●Unit Heater & Cooler Co., Wausau, Wis.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
X L Refrigerating Co., Chicago, Ill.
●York Ice Machinery Corp., York, Pa.

COOLERS, UNIT (SUSPENDED TYPE)

Not air conditioning units, but suspended unit with coil and propellor fan, without filters, for connection to remote compressor or cold water supply. For air conditioning units, see Units, Air Conditioning

Acme Industries, Inc., Jackson, Mich.
American Blower Corp., Detroit, Mich.
●Baker Ice Machine Co., Inc., Omaha, Nebr.
Ballantyne Co., Omaha, Neb.
Berns Specialty Co., Chicago, Ill.
●Buffalo Forge Co., Buffalo, N. Y.
Bush Mfg. Co., Hartford, Conn.
●Carrier Corp., Syracuse, N. Y.
●Clarage Fan Co., Kalamazoo, Mich.
Conditionaire Unit Co., Chicago, Ill.
Coolmaster Corp., Chicago, Ill. (Evaporative cooling principle, no dehumidifying)
●Curtis Refrigerating Machine Co., St. Louis, Mo.
Drayer & Hanson, Inc., Los Angeles, Cal.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.

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●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
General Refrigeration Corp., Beloit, Wis.
Hastings Air Conditioning Co., Hastings, Neb.
Howe Ice Machine Co., Chicago, Ill.
Ilg Electric Ventilating Co., Chicago, Ill.
Johnson Fan & Blower Corp., Chicago, Ill.
Kauffman Air Conditioning Corp., St. Louis, Mo.
King Ventilating Co., Owatonna, Minn.
Kramer Trenton Co., Trenton, N. J.
Larkin Coils, Inc., Atlanta, Ga.
●Marlo Coil Co., St. Louis, Mo.
●McQuay, Inc., Minneapolis, Minn.
Merchant & Evans Co., Philadelphia, Pa.
Modine Mfg. Co., Racine, Wis.
Norge Div., Borg-Warner Corp., Detroit, Mich.
Peerless of America, Inc., Chicago, Ill.
Refrigeration Appliances, Inc., Chicago, Ill.
Refrigeration Economics Co., Inc., Canton, O.
●Rempe Co., Chicago, Ill.
Richmond Engrg. Co., Inc., Richmond, Va.
●St. Louis Blow Pipe & Heater Co., St. Louis, Mo.
Simmons Co., Gordon H., Milwaukee, Wis.
Super Radiator Corp., Minneapolis, Minn.
Thermal Co., Inc., Milwaukee, Wis.
●Trane Co., LaCrosse, Wis.
●U. S. Air Conditioning Corp., Minneapolis, Minn.
●Unit Heater & Cooler Co., Wausau, Wis.
●Vilter Mfg. Co., Milwaukee, Wis.
●Wing Mfg. Co., L. J., New York, N. Y.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
X L Refrigerating Co., Chicago, Ill.
●York Ice Machinery Corp., York, Pa.
●Young Radiator Co., Racine, Wis.

COOLING COILS

See Surface, Cooling

COOLING SURFACE

See Surface, Cooling

COOLING TOWERS

See Towers, Cooling

COOLING UNITS

See Units, Air Conditioning; Coolers, Unit

COPPER PIPE

See Pipe, Brass and Copper

COPPER SHEETS

See Sheets, Copper

COPPER TUBE FITTINGS

See Fittings, Copper Tube

COPPER TUBING

See Tubing, Brass and Copper

COUNTERS, DUST

Bausch & Lomb Optical Co., Rochester, N. Y.
Service to Industry, West Hartford, Conn.
Willson Products, Inc., Reading, Pa.

COUPLINGS, FLEXIBLE, POWER TRANSMISSION

Ajax Flexible Coupling Co., Westfield, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Flexible Coupling Co., Erie, Pa.
Bartlett Hayward Co., Baltimore, Md.
Blood Brothers, Allegan, Mich. (Universal joints)
Boston Gear Wks., Inc., North Quincy, Mass.
Caldwell Co., W. E., Louisville, Ky.
Certified Flexible Couplings, Inc., New York, N. Y.
Chain Belt Co., Milwaukee, Wis.
Chicago Die Casting Mfg. Co., Chicago, Ill.
Continental Diamond Fibre Co., Newark, Del.
Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.
De Laval Steam Turbine Co., Trenton, N. J.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Dodge Mfg. Corp., Mishawaka, Ind.
Flexo Supply Co., Inc., St. Louis, Mo.
Frederick Iron & Steel Co., Frederick, Md.
Guardian Utilities Co., Michigan City, Ind.
Jones Foundry & Machine Co., W. A., Chicago, Ill.
Kraissl Co., Inc., The, Hackensack, N. J.
Lewis & Co., Inc., Chas. S., St. Louis, Mo.
Link-Belt Co., Chicago, Ill.
Lord Mfg. Co., Erie, Pa.
Lovejoy Flexible Coupling Co., Chicago, Ill.
Medart Co., St. Louis, Mo.
Monarch Mfg. Works, Inc., Philadelphia, Pa.
Moran Flexible Steam Joint Co., Louisville, Ky.
Morse Chain Co., Ithaca, N. Y.
Poole Foundry & Machine Co., Baltimore, Md.
Shallcross Co., Philadelphia, Pa.
Smith, Inc., Winfield H., Springville, N. Y.
Strong-Scott Mfg. Co., Minneapolis, Minn.
Waldron Corp., John, New Brunswick, N. J.
Whitney Chain & Mfg. Co., The, Hartford, Conn.

COUPLINGS, PIPE

Barco Mfg. Co., Chicago, Ill. (Flexible).
●Byers Co., A. M., Pittsburgh, Pa.
Champion Machine & Forging Co., Cleveland, O.
Clow & Sons, James B., Chicago, Ill.
Colonial Alloys Co., Specialties Div., Philadelphia, Pa.
Crane Co., Chicago, Ill.
Detroit Brass & Malleable Works, Detroit, Mich.
●Devlin Mfg. Co., Inc., Thos., Burlington, N. J.
Dresser Mfg. Co., Bradford, Pa.
Flagg & Co., Inc., Stanley G., Philadelphia, Pa.
Grabler Mfg. Co., Cleveland, O.
●Grinnell Co., Inc., Providence, R. I.
H. & B. Sales Co., Ltd., Long Beach, Cal. (Swing joint)
Harrisburg Steel Corp., Harrisburg, Pa.
Hasco Valve & Machine Co., Milwaukee, Wis.
Hatch, George E., New York, N. Y.
Illinois Malleable Iron Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Jefferson Union Co., Lexington, Mass.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Kennedy Valve Mfg. Co., Elmira, N. Y.
King Union Co., Inc., Hillsgrove, R. I.
●Malleable Iron Fittings Co., Branford, Conn.
●Mueller Brass Co., Port Huron, Mich.
National Tube Co., United States Steel Corp. Sub., Pittsburgh, Pa.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Ravena Iron Co., Ravena, N. Y. (Cast iron).
Semler Co., Jeannette, Pa.
Standard Auto-Tite Joint Co., Pittsburgh, Pa.
Stockham Pipe Fittings Co., Birmingham, Ala.
Stokes Rubber Co., Jos., Trenton, N. J. (Hard rubber).
●Streamline Pipe & Fittings Div., Mueller Brass Co., Port Huron, Mich.
Taylor Forge & Pipe Wks., Chicago, Ill.
Victaulic Co. of America, New York, N. Y.
Walworth Co., New York, N. Y.
Ward Foundries, Inc., J. P., Blossburgh, Pa.
●Watson-Stillman Co., Roselle, N. J.
Weatherhead Co., Cleveland, O.

CUT-OFFS, LOW WATER, HEATING BOILER

●Bishop & Babcock Mfg. Co., Cleveland, O.
●Detroit Lubricator Co., Detroit, Mich.
●Maid-O-Mist, Inc., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
McDonnell & Miller, Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Penn Electric Switch Co., Goshen, Ind.
Schaub Engineering Co., Fred H., Chicago, Ill.
Watts Regulator Co., Lawrence, Mass.
●Webster & Co., Warren, Camden, N. J.
Wright-Austin Co., Detroit, Mich.

CUTTERS, PIPE

American Pipe Tool Co., Chicago, Ill.
Armstrong Bros. Tool Co., Chicago, Ill.
Armstrong Mfg. Co., Bridgeport, Conn.
Barnes Tool Co., The, New Haven, Conn.
Beaver Pipe Tools, Inc., Warren, O.
Bernz Co., Inc., Otto, Rochester, N. Y.
Crown Die & Tool Co., Chicago, Ill.
Erie Tool Works, Erie, Pa.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hollands Mfg. Co., Erie, Pa.
Imperial Brass Mfg. Co., Chicago, Ill.
International Nutyp Tool Corp., Oswego, N. Y.
Jarecki Mfg. Co., Erie, Pa.
National Machine Wks., Chicago, Ill.
Nye Tool & Machine Works, The, Chicago, Ill.
Oster Mfg. Co., Cleveland, O.
Ridge Tool Co., Elyria, O.
Sac Tool Mfg. Co., St. Louis, Mo.
Toledo Pipe Threading Machine Co., Toledo, O.
Trimont Mfg. Co., Boston, Mass.
Vanderman Mfg. Co., Willimantic, Conn.
Wallace Supplies Mfg. Co., Chicago, Ill.
Weatherhead Co., Cleveland, O.

CUTTERS, TUBING

Armstrong Bros. Tool Co., Chicago, Ill.
Armstrong Mfg. Co., Bridgeport, Conn.
Barnes Tool Co., The, New Haven, Conn.
Beaver Pipe Tools, Inc., Warren, O.
Bernz Co., Inc., Otto, Rochester, N. Y.
Imperial Brass Mfg. Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Nye Tool & Machine Works, The, Chicago, Ill.
Parker Appliance Co., Cleveland, O.
Ridge Tool Co., Elyria, O.
Sac Tool Mfg. Co., St. Louis, Mo.
Snap-On Tools Corp., Kenosha, Wis.
●Streamline Pipe & Fittings Div., Mueller Brass Co., Port Huron, Mich.
Trimont Mfg. Co., Boston, Mass.
Wallace Supplies Mfg. Co., Chicago, Ill.

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DAMPER OPERATORS
See Operators, Damper

DAMPER QUADRANTS
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DAMPERS, DUCT, REMOTE CONTROLLED
American Warming & Ventilating Co., Toledo, O.
●Au-Temp-Co Corp., New York, N. Y.
●Barber-Colman Co., Rockford, Ill.
Brooke Engineering Co., Inc., Philadelphia, Pa.
●Johnson Service Co., Milwaukee, Wis.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Penn Electric Switch Co., Goshen, Ind.
●Powers Regulator Co., Chicago, Ill.
Stuart Co., W. W., Des Moines, Ia.
Shallcross Controls, Inc., Milwaukee, Wis.
Tuttle & Bailey, Inc., New Britain, Conn.
Young Regulator Co., Cleveland, O.

DEAERATORS
●Cochrane Corp., Philadelphia, Pa.
Croll-Reynolds Engrg. Co., Inc., New York, N. Y.
Elliott Co., Jeannette, Pa.
Hoppes Mfg. Co., Springfield, O.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.

DEEP WELL PUMPS
See Pumps, Deep Well

DEHUMIDIFIERS, ABSORPTION AND ADSORPTION
●Air & Refrigeration Corp., New York, N. Y.
American Injector Co., Detroit, Mich.
Aqua-Sorb Co., East Orange, N. J.
Bryant Heater Co., The, Cleveland, O. (Silica gel)
●Carrier Corp., Syracuse, N. Y.
Pittsburgh Lectrodryer Corp., Pittsburgh, Pa.
Research Corp., New York, N. Y.
Surface Combustion Corp., Toledo, O.

DEHUMIDIFYING UNITS
See Units, Air Conditioning; Dehumidifiers, Absorption and Adsorption

DETECTORS, LEAK, REFRIGERANT
Bernz Co., Inc., Otto, Rochester, N. Y.
Hull Mfg. Co., Hagerstown, Md.
Imperial Brass Mfg. Co., Chicago, Ill.
Linde Air Products Co., The, Unit of Union Carbide & Carbon Corp., New York, N. Y.
Turner Brass Wks., Sycamore, Ill.

DIAPHRAGM VALVES
See Valves, Diaphragm

DIESEL ENGINES
See Engines, Diesel for Fan, Pump and Compressor Drives

DIFFUSERS, AIR, HIGH VELOCITY
Anemostat Corp. of America, New York, N. Y.
●Barber-Colman Co., Rockford, Ill.

DOORS AND PANELS, ACCESS
American Foundry & Furnace Co., Bloomington, Ill.
American Sheet Metal Works, New Orleans, La.
●Auer Register Co., Cleveland, O.
●Clarage Fan Co., Kalamazoo, Mich.
Falstrom Co., Passaic, N. J.
Higgin Products, Inc., Newport, Ky.
Kirk & Blum Mfg. Co., Cincinnati, O.
Lawson Co., F. H., Cincinnati, O.
Milcor Steel Co., Milwaukee, Wis.
Rock Island Register Co., Rock Island, Ill.
Truscon Steel Co., Youngstown, O.
●Tuttle & Bailey, Inc., New Britain, Conn.
Walsh-Spencer Co., Boston, Mass.
Way Panel Loctor Co., Wollaston, Mass.

DRAFT GAGES
See Gages, Indicating, Draft

DRAFT RECORDERS
See Recorders, Draft

DRAFT REGULATORS
See Regulators, Draft, Combustion

DRILLS, ELECTRIC, PORTABLE
Black & Decker Mfg. Co., Towson, Md.
Chicago Pneumatic Tool Co., New York, N. Y.
Clark, Jr., Electric Co., Jas., Louisville, Ky.
Independent Pneumatic Tool Co., Chicago, Ill.
Mall Tool Co., Chicago, Ill.
Millers Falls Co., Greenfield, Mass.
Misener Mfg. Co., Inc., Syracuse, N. Y.
Power King Tool Corp., Warsaw, Ind.
Signal Electric Mfg. Co., Menominee, Mich.
Skilsaw, Inc., Chicago, Ill.
Snap-On Tools Corp., Kenosha, Wis.
Speedway Mfg. Co., Chicago (Cicero), Ill.
Stanley Wks., New Britain, Conn.
U. S. Electrical Tool Co., Cincinnati, O.
Wodack Electric Tool Corp., Chicago, Ill.

DRIVES, CHAIN
Boston Gear Works, Inc., North Quincy, Mass.
Caldwell Co., W. E., Louisville, Ky.
Chain Belt Co., Milwaukee, Wis.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Medart Co., St. Louis, Mo.
Morse Chain Co., Ithaca, N. Y.
Ramsey Chain Co., Inc., Albany, N. Y.
Whitney Chain & Mfg. Co., The, Hartford, Conn.

DRIVES, FLAT BELT
See also Belting, Leather and Belting, Rubber
American Pulley Co., Philadelphia, Pa.
Browning Mfg. Co., Inc., Maysville, Ky.
Caldwell Co., W. E., Louisville, Ky.
Chicago Belting Co., Chicago, Ill.
Chicago Die Casting Mfg. Co., Chicago, Ill.
Continental Rubber Wks., Erie, Pa.
Dick Co., Inc., R. & J., Passaic, N. J.
Dodge Mfg. Corp., Mishawaka, Ind.
Medart Co., St. Louis, Mo.
●Rhoads & Sons, J. E., Philadelphia, Pa.
Rockwood Mfg. Co., Indianapolis, Ind.
Smith, Inc., Winfield H., Springfield, N. Y.
Williams & Son, I. B., Dover, N. H.
Wood's Sons Co., T. B., Chambersburg, Pa.

DRIVES, V BELT
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Pulley Co., Philadelphia, Pa.
Boston Gear Wks., Inc., North Quincy, Mass.
Browning Mfg. Co., Inc., Maysville, Ky.
Chicago Belting Co., Chicago, Ill.
Chicago Die Casting Mfg. Co., Chicago, Ill.
Continenta. Rubber Wks., Erie, Pa.
Dayton Rubber Mfg. Co., Dayton, O.
Dick Co., Inc., R. & J., Passaic, N. J.
Dodge Mfg. Corp., Mishawaka, Ind.
Fairbanks, Morse & Co., Chicago, Ill.
Gates Rubber Co., Denver, Colo.
Goodrich Co., B. F., Akron, O.
Horton Mfg. Co., Minneapolis, Minn.
Jones Foundry & Machine Co., W. A., Chicago, Ill.
Medart Co., St. Louis, Mo.
Pyott Foundry & Machine Co., Chicago, Ill.
Rockwood Mfg. Co., Indianapolis, Ind.
Smith, Inc., Winfield H., Springville, N. Y.
Wood's Sons Co., T. B., Chambersburg, Pa.
●Worthington Pump & Machinery Corp., Harrison, N. J.

DUAL THERMOSTATS
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DUCT CONNECTIONS
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DUCT HEATERS
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DUCT INSULATION
See Insulation, Duct

DUCT THERMOSTATS
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DUCT TURNING VANES
See Vanes, Duct Turning, Prefabricated

DUCTS AND DUCT FITTINGS, PREFABRICATED
Acer & Whedon, Medina, N. Y.
Acme Tin Plate & Roofing Supply Co., Philadelphia, Pa.
●Carey Co., Philip, Cincinnati, O.
Champion Furnace Pipe Co., Peoria, Ill.
Chandler Co., Cedar Rapids, Ia.
Char-Gale Mfg. Co., Minneapolis, Minn.
Chicago Furnace Supply Co., Chicago, Ill.
Cincinnati Sheet Metal & Roofing Co., Cincinnati, O.
Corbman Bros., Inc., Philadelphia, Pa.
Excelsior Steel Furnace Co., Chicago, Ill.
●Henry Furnace & Foundry Co., Cleveland, O.
Howes Co., S. M., Charlestown, Boston, Mass.
Lamneck Products, Inc., Columbus, O.
Meyer & Bro. Co., F., Peoria, Ill.
Milcor Steel Co., Milwaukee, Wis.
Moncrief Furnace Co., Atlanta, Ga.
Mueller Furnace Co., L. J., Milwaukee, Wis.
United States Register Co., Battle Creek, Mich.
Williamson Heater Co., Cincinnati, O.

DUST COLLECTORS
See Collectors, Dust

DUST COUNTERS
See Counters, Dust

EJECTORS, SEWAGE

American-Marsh Pumps, Inc., Battle Creek, Mich.
Chicago Pump Co., Chicago, Ill.
Columbus Steam Pump Works Co., Columbus, O.
Economy Pumps, Inc., Chicago, Ill.
●Nash Engineering Co., South Norwalk, Conn.
Penberthy Injector Co., Detroit, Mich.
Quimby Pump Co., Inc., Newark, N. J.
Taber Pump Co., Inc., Buffalo, N. Y.
Weil Pump Co., Chicago, Ill.
Yeomans Bros. Co., Chicago, Ill.

ELECTRIC DRILLS

See Drills, Electric, Portable

ELECTRIC MOTORS

See Motors, Electric

ELECTRIC SHEARS

See Shears, Electric, Portable

ELECTRIC UNIT HEATERS

See Heaters; Unit, Electric Heating Element

ELECTRIC AIR CLEANERS

See Cleaners, Air, Electrical

ELECTRODES, ARC WELDING

Aluminum Co. of America, Pittsburgh, Pa.
●American Brass Co., Waterbury, Conn.
Arcos Corp., Philadelphia, Pa.
General Electric Co., Schenectady, N. Y.
Harnischfeger Corp., Milwaukee, Wis.
Hobart Bros., Troy, O.
Lincoln Electric Co., Cleveland, O.
Marquette Mfg. Co., Minneapolis, Minn.
Maurath, Inc., Cleveland, O.
McKay Co., Pittsburgh, Pa.
Metal & Thermit Corp., New York, N. Y.
Page Steel & Wire Division of American Chain & Cable Co., Inc., Monessen, Pa.
Roebling's Sons, John A., Trenton, N. J.
Seneca Wire & Mfg. Co., Fostoria, O.
Torchweld Equipment Co., Div. of National Cylinder Gas Co., Chicago, Ill.
Una Welding, Inc., E. Cleveland, O.
Universal Power Corp., Cleveland, O.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Wilson Welder & Metals Co., Inc., New York, N. Y.

ELIMINATORS, AIR, FOR HEATING SYSTEMS

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Anderson Products, Inc., Cambridge, Mass.
Barnes & Jones, Inc., Jamaica Plain, Boston, Mass.
Beaton & Cadwell Mfg. Co., New Britain, Conn.
●Dunham Co., C. A., Chicago, Ill.
Gorton Heating Corp., Cranford, N. J.
Hoffman Specialty Co., Inc., Waterbury, Conn.
●Illinois Engineering Co., Chicago, Ill.
●Maid-O-Mist, Inc., Chicago, Ill.
Marsh Corp., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Mueller Steam Specialty Co., Inc., New York, N. Y.
●Sarco Co., Inc., New York, N. Y.
Sterling Engineering Co., Milwaukee, Wis.
●Trane Co., La Crosse, Wis.
Vapor Specialty Co., New York, N. Y.
●Webster & Co., Warren, Camden, N. J.
Wright-Austin Co., Detroit, Mich.

ENAMELS AND LACQUERS

Baer Bros., New York, N. Y.
Barrett Co., The, New York, N. Y.
Debevoise Co., The, Brooklyn, N. Y.
du Pont de Nemours & Co. (Inc.), E. I., Fabrics & Finishes Dept., Wilmington, Del.
Hague & Co., Inc., Alfred, Brooklyn, N. Y.
Hilo Varnish Corp., Brooklyn, N. Y.
Horn Co., A. C., Long Island City, N. Y.
Inter-Coastal Paint Corp., East St. Louis, Ill.
Krehbiel, J. H., Chicago, Ill.
Maas & Waldstein Co., Newark, N. J.
O'Brien Varnish Co., South Bend, Ind.
Roxalin Flexible Lacquer Co., Inc., Elizabeth, N. J.
Wailes Dove-Hermiston Corp., New York, N. Y.
Wilhelm Co., A., Reading, Pa.
Zapon-Brevolite Div., Atlas Powder Co., North Chicago, Ill.

ENGINES, DIESEL, FOR FAN, PUMP AND COMPRESSOR DRIVES

American Locomotive Co., Auburn, N. Y.
Anderson Engine & Foundry Co., Anderson, Ind.
Buda Co., Harvey, Ill.
Caterpillar Tractor Co., Peoria, Ill.
Chicago Pneumatic Tool Co., New York, N. Y.
De La Vergne Engine Co., Philadelphia, Pa.
Fairbanks, Morse & Co., Chicago, Ill.
General Motors Corp., Detroit, Mich.
Hill Diesel Engine Co., Lansing, Mich.
Ingersoll-Rand, New York, N. Y.
Waukesha Motor Co., Waukesha, Wis.
●Worthington Pump & Machinery Corp., Harrison, N. J.

ENGINES, GAS, FOR FAN, PUMP AND COMPRESSOR DRIVES

Bardco Corp. of America, Los Angeles, Cal.
Caterpillar Tractor Co., Peoria, Ill.
Chicago Pneumatic Tool Co., New York, N. Y.
Continental Motors Corp., Detroit, Mich.
Fairbanks, Morse & Co., Chicago, Ill.
Lycoming Mfg. Co., Williamsport, Pa.
U. S. Motors Corp., Oshkosh, Wis.
Universal Motor Co., Oshkosh, Wis.
Waukesha Motor Co., Waukesha, Wis.
●Worthington Pump & Machinery Corp., Harrison, N. J.

ENGINES, STEAM, FOR FAN, PUMP AND COMPRESSOR DRIVES

Ames Iron Wks., Div. of Pierce, Butler Radiator Corp., Oswego, N. Y.
Elliott Co., Jeannette, Pa.
●Frick Co., Waynesboro, Pa.
Harrisburg Fdry. & Mach. Co., Inc., Harrisburg, Pa.
Morris Machine Wks., Baldwinsville, N. Y.
Murray Iron Wks Co., Burlington, Ia.
Pierce, Butler Radiator Corp., Syracuse, N. Y.
Skinner Engine Co., Erie, Pa.
●Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Troy Engine & Machine Co., Troy, Pa.
●Vilter Mfg. Co., Milwaukee, Wis.

EVAPORATIVE CONDENSERS

See Condensers, Refrigerating, Evaporative

EXPANSION BENDS

See Bends, Expansion

EXPANSION BOLTS

See Bolts, Expansion

EXPANSION JOINTS

See Joints, Pipe, Expansion

EXPANSION VALVES

See Valves, Refrigeration

EXTRACTORS, PIPE

Greenfield Tap & Die Corp., Greenfield, Mass.
Reps Tool, Inc., Buffalo, N. Y.
Ridge Tool Co., Elyria, O.

FABRICATED PIPING

See Bends; Headers; Joints; etc.

FAN BASES

See Bases and Pads, Vibration Isolating

FAN BLADES

See Blades, Propeller Fan

FANS, CENTRIFUGAL

Advance Aluminum Castings Corp., Chicago, Ill.
Advance Fan & Blower Co., Detroit, Mich.
●Air Controls, Inc., Cleveland, O.
●Airtherm Mfg. Co., St. Louis, Mo.
Allen Billmyre Corp., New York, N. Y.
American Blower Corp., Detroit, Mich.
American Foundry & Furnace Co., Bloomington, Ill.
Ames Co., W. R., San Francisco, Cal.
Atlas Heating & Ventilating Co., Ltd., San Francisco, Cal.
●Autovent Fan & Blower Co., Chicago, Ill.
Ballantyne Co., Omaha, Nebr.
Bayley Blower Co., Milwaukee, Wis.
Berns Specialty Co., Chicago, Ill.
●Bishop & Babcock Mfg. Co., Cleveland, O.
Blower Application Co., Milwaukee, Wis.
Brundage Co., Kalamazoo, Mich.
●Buffalo Forge Co., Buffalo, N. Y.
Campbell Heating Co., Des Moines, Ia.
Champion Blower & Forge Co., Lancaster, Pa.
●Clarage Fan Co., Kalamazoo, Mich.
Columbus Heating & Ventilating Co., Columbus, O.
Coppus Engineering Corp., Worcester, Mass.
De Bothezat Ventilating Equipment Div., American Machine & Metals, Inc., New York, N. Y.
Duriron Co., Inc., Dayton, O. (Acid resisting).
Eclipse Fuel Engineering Co., Rockford, Ill.
Economy Electric Mfg. Co., Chicago, Ill.
Electrovent Fan & Mfg. Co., Chicago, Ill.
Garden City Fan Co., Chicago, Ill.
General Blower Co., Inc., Philadelphia, Pa.
Grand Rapids Die & Tool Co., Grand Rapids, Mich.
Hastings Air Conditioning Co., Hastings, Neb.
Hirschman Co., W. F., Buffalo, N. Y.
Ilg Electric Ventilating Co., Chicago, Ill.
Jaden Mfg. Co., Inc., F., Hastings, Nebr.
Janette Mfg. Co., Chicago, Ill.
Johnson Fan & Blower Corp., Chicago, Ill.
King Ventilating Co., Owatonna, Minn.

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Lau Blower Co., Dayton, O.
Lehigh Fan & Blower Co., Allentown, Pa.
Magirl Foundry & Furnace Works, P. H., Bloomington, Ill.
Metal Stamping & Mfg. Co., The, Cleveland, O.
Montag Stove & Furnace Wks., Portland, Ore.
Mountain States Equipment Co., Denver, Colo.
New York Blower Co., Chicago, Ill.
Niagara Blower Co., New York, N. Y.
Northern Blower Co., Cleveland, O.
Peerless Electric Co., Warren, O.
Phelps Mfg. Co., Little Rock, Ark.
Schwitzer-Cummins Co., Indianapolis, Ind.
Smith Heater Co., Peter, Detroit, Mich.
Spray-Wheel Air Conditioners, Inc., Denver, Colo.
Star Radiator Co., Los Angeles, Cal.
●Sturtevant Co., B. F., Boston, Mass.
Supreme Heater & Ventilating Corp., Bonner Springs, Kans.
Todd Air Conditioning Co., Inc., Bonner Springs, Kans.
●Torrington Mfg. Co., Torrington, Conn.
●Trane Co., LaCrosse, Wis.
●U. S. Air Conditioning Corp., Minneapolis, Minn.
Utility Fan Corp., Los Angeles, Cal.
Viking Air Conditioning Corp., Cleveland, O.
Western Blower Co., Seattle, Wash.
●Wing Mfg. Co., L. J., New York, N. Y.
Wolverine Blower Works, Grand Rapids, Mich.

FANS, PROPELLER

Aerovent Fan Co., Piqua, O.
●Air Controls, Inc., Cleveland, O.
Aircraft Mfg. Co., Dayton, O.
Aire-Foile Fan & Blower Co., Detroit, Mich.
Airmaster Corp., Chicago, Ill.
●Airtherm Mfg. Co., St. Louis, Mo.
Allen Corp., Detroit, Mich.
American Blower Corp., Detroit, Mich.
American Coolair Corp., Jacksonville, Fla.
Ames Co., W. R., San Francisco, Cal.
●Autovent Fan & Blower Co., Chicago, Ill.
Bayley Blower Co., Milwaukee, Wis.
Belanger Fan & Blower Co., Detroit, Mich.
Belco Exhaust Fan Mfg. Co., St. Louis, Mo.
Berns Specialty Co., Chicago, Ill.
●Bishop & Babcock Mfg. Co., Cleveland, O.
●Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.
Chelsea Fan & Blower Co., New York, N. Y.
Circulators & Devices Mfg. Corp., New York, N. Y.
●Clarage Fan Co., Kalamazoo, Mich.
Coppus Engineering Corp., Worcester, Mass.
De Bothezat Ventilating Equipment Div., American Machine & Metals, Inc., New York, N. Y.
Diehl Mfg. Co., Elizabethport, N. J.
Economy Electric Mfg. Co., Chicago, Ill.
Electrovent Fan & Mfg. Co., Chicago, Ill.
Emerson Electric Mfg. Co., St. Louis, Mo.
Fresh'nd-Aire Co., Chicago, Ill.
Garden City Fan Co., Chicago, Ill.
Gas City Glass Co., Gas City, Ind.
General Blower Co., Inc., Philadelphia, Pa.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
General Regulator Corp., Chicago, Ill.
Grand Rapids Blow Pipe & Dust Arrester Co., Grand Rapids, Mich.
●Hall Mfg. Co., Cedar Rapids, Ia.
Hartzell Propeller Fan Co., Piqua, O.
Hirschman Co., W. F., Buffalo, N. Y.
Hudson Equipment Corp., Minneapolis, Minn.
Ilg Electric Ventilating Co., Chicago, Ill.
International Engineering, Inc., Dayton, O.
Johnson Fan & Blower Corp., Chicago, Ill.
Johnston Co., William W., Dayton, O.
Jordan & Co., Paul R., Indianapolis, Ind.
King Ventilating Co., Owatonna, Minn.
Kisco Co., Inc., St. Louis, Mo.
Lohman, Inc., Wm. J., New York, N. Y.
Lau Blower Co, Dayton, O.
Marathon Electric Mfg. Corp., Wausau, Wis.
Meier Electric & Machine Co., Indianapolis, Ind.
Metal Stamping & Mfg. Co., The, Cleveland, O.
Mountain States Equipment Co., Denver, Colo.
Myers Electric Co., Pittsburgh, Pa.
New York Blower Co., Chicago, Ill.
Peerless Electric Co., Warren, O. (Disc).
Perkins & Son, Inc., B. F., Holyoke, Mass.
Phelps Mfg. Co., Little Rock, Ark.
Propellair, Inc., Springfield, O.
Reed Unit-Fans, Inc., New Orleans, La.
Reynolds Electric Co., Chicago, Ill.
Schwitzer-Cummins Co., Indianapolis, Ind.
Signal Electric Mfg. Co., Menominee, Mich.
South Bend Air Products Corp., South Bend, Ind.
●Sturtevant Co., B. F., Boston, Mass.
●Torrington Mfg. Co., Torrington, Conn.
●U S. Air Conditioning Corp., Minneapolis, Minn.
Utility Fan Corp., Los Angeles, Cal.
Victor Electric Products, Inc., Cincinnati, O.
Viking Air Conditioning Corp., Cleveland, O.
Western Blower Co., Seattle, Wash.
Western Engineering & Mfg. Co., Los Angeles, Cal.
●Wing Mfg. Co., L. J., New York, N. Y.

FEEDERS, WATER, HEATING BOILER

Beaton & Cadwell Mfg. Co., New Britain, Conn.
Cissell Mfg. Co., W. M., Louisville, Ky.
Davis Regulator Co., Chicago, Ill.
Eclipse Fuel Engineering Co., Rockford, Ill.
Healy Ruff Co., St. Paul, Minn.
Kisco Boiler & Engineering Co., St. Louis, Mo.
●Maid-O-Mist, Inc., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
McDonnell & Miller, Chicago, Ill.
Mears-Kane-Ofeldt, Inc., Philadelphia, Pa.
Mueller Steam Specialty Co., Inc., New York, N. Y.
Nason Co., Detroit, Mich.
Sterling Engineering & Mfg. Corp., Hyde Park, Mass.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Watts Regulator Co., Lawrence, Mass.
●Webster & Co., Warren, Camden, N. J.
Wright-Austin Co., Detroit, Mich.

FIBER PACKING

See Packing, Fiber

FILTER GAGES

See Gages, Air Filter

FILTERS, AIR, AUTOMATIC

●Air & Refrigeration Corp., New York, N. Y.
Air-Stream Filter Corp., St. Louis, Mo.
●American Air Filter Co., Inc., Louisville, Ky.
Coppus Engineering Corp., Worcester, Mass.
Dracco Corp., Cleveland, O.
Northern Blower Co., Cleveland, O.
●Staynew Filter Corp., Rochester, N. Y.

FILTERS, AIR, UNIT, CLEANABLE

●Air-Maze Corp., Cleveland, O.
●American Air Filter Co., Inc., Louisville, Ky.
American Foundry & Furnace Co., Bloomington, Ill.
Amirton Co., New York, N. Y.
Annis Air Filters, Glendale, Cal.
Chicago Filter Co., Joliet, Ill.
Coppus Engineering Corp., Worcester, Mass.
Davies Air Filter Corp., New York, N. Y.
Hugo Mfg. Co., West Duluth, Minn.
Kleenaire Corp., Stevens Point, Wis.
Kraissl Co., Inc., The, Hackensack, N. J.
Somers, Inc., H. J., Detroit, Mich.
●Staynew Filter Corp., Rochester, N. Y.
Supreme Air Filter Co., New York, N. Y.
Tuttle Air Filter Co., Inc., Louisville, Ky.
Universal Air Filter Corp., Duluth, Minn.

FILTERS, AIR, UNIT, THROW-AWAY

●American Air Filter Co., Inc., Louisville, Ky.
Amirton Co., New York, N. Y.
Blocksom & Co., Michigan City, Ind.
Chicago Filter Co., Joliet, Ill.
Davies Air Filter Corp., New York, N. Y.
●Detroit Lubricator Co., Detroit, Mich.
Gehri Co., Tacoma, Wash.
Kleenaire Corp., Stevens Point, Wis.
●Owens-Corning Fiberglas Corp., Toledo, O.
Plymouth Cordage Co., N. Plymouth, Mass.; Anderson Products, Inc., Cambridge, Mass. National Sales Agents.
Research Products Corp., Madison, Wis.
●Staynew Filter Corp., Rochester, N. Y.
Universal Air Filter Corp., Duluth, Minn.
Wilson & Co., Chicago, Ill.

FILTERS, PIPE LINE

Adams Co., R. P., Buffalo, N. Y.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Cuno Engineering Corp., Meriden, Conn.
Filtrine Mfg. Co., Inc., Brooklyn, N. Y.
Fisher Governor Co., Marshalltown, Ia.
Johnson Corp., Three Rivers, Mich.
Mason-Neilan Regulator Co., Boston, Mass.
Newark Wire Cloth Co., Newark, N. J.
Norwood Filtration Co., The, Florence, Mass.
Permutit Co., New York, N. Y.
Refinite Corp., Omaha, Neb.
●Staynew Filter Corp., Rochester, N. Y.
Superior Valve & Fittings Co., Pittsburgh, Pa.

FINNED TUBING

See Tubing, Finned

FIRE PUMPS

See Pumps, Fire

FITTINGS, COPPER TUBE, COMPRESSION

●American Brass Co., Waterbury, Conn.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Crane Co., Chicago, Ill.
Hays Mfg. Co., Erie, Pa.
Imperial Brass Mfg. Co., Chicago, Ill.
●Mueller Brass Co., Port Huron, Mich.
Northern Indiana Brass Co., Elkhart, Ind.
Parker Appliance Co., Cleveland, O.

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Phoenix Brass Fittings Corp., Irvington, N. J.
Revere Copper & Brass, Inc., New York, N. Y.
●Streamline Pipe & Fittings Div., Mueller Brass Co., Port Huron, Mich.
Superseal Corp., New York, N. Y.
VibraSeal Corp., Detroit, Mich.

FITTINGS, COPPER TUBE, SOLDER

●American Brass Co., Waterbury, Conn.
American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Crane Co., Chicago, Ill.
Flagg & Co., Inc., Stanley G., Philadelphia, Pa.
Grabler Mfg. Co., Cleveland, O.
Imperial Brass Mfg. Co., Chicago, Ill.
●Mueller Brass Co., Port Huron, Mich.
Northern Indiana Brass Co., Elkhart, Ind.
Parker Appliance Co., Cleveland, O.
Revere Copper & Brass, Inc., New York, N. Y.
●Streamline Pipe & Fittings Div., Mueller Brass Co., Port Huron, Mich.
Walworth Co., New York, N. Y.

FITTINGS, LINED

Alpha Metal & Rolling Mills, Inc., Brooklyn, N. Y.
Goodrich Co., B. F., Akron, O. (Rubber)
Lead Lined Iron Pipe Co., Wakefield, Mass. (Lead and tin)
National Lead Co., New York, N. Y. (Lead)
Northern Indiana Brass Co., Elkhart, Ind. (Tinned)
Resisto Pipe & Valve Co., East Cambridge, Mass.
United States Rubber Co., New York, N. Y. (Rubber)

FITTINGS, PIPE, BRASS, SOLDER

Crane Co., Chicago, Ill.
Imperial Brass Mfg. Co., Chicago, Ill.
●Mueller Brass Co., Port Huron, Mich.
Northern Indiana Brass Co., Elkhart, Ind.
●Streamline Pipe & Fittings Div., Mueller Brass Co., Port Huron, Mich.
Walworth Co., New York, N. Y. (Brazed)

FITTINGS, PIPE, BRASS, THREADED

Acheson Mfg. Co., Rankin, Pa.
American Manganese Bronze Co., Philadelphia, Pa.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Commonwealth Brass Corp., Detroit, Mich.
Crane Co., Chicago, Ill.
●Devlin Mfg. Co., Inc., Thos., Burlington, N. J.
Flagg & Co., Inc., Stanley G., Philadelphia, Pa.
General Fittings Co., Providence, R. I.
Grabler Mfg. Co., Cleveland, O.
●Grinnell Co., Inc., Providence, R. I.
Imperial Brass Mfg. Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Jenkins Mfg. Co., Elmira, N. Y.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Lunkenheimer Co., Cincinnati, O.
●Mueller Brass Co., Port Huron, Mich.
New York Brass Fdry., New York, N. Y.
Northern Indiana Brass Co., Elkhart, Ind.
Penn Mfg. Corp. of Washington, Pa., Washington, Pa.
Phoenix Brass Fittings Corp., Irvington, N. J.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Rockford Brass Works, Rockford, Ill.
●Streamline Pipe & Fittings Div., Mueller Brass Co., Port Huron, Mich.
Union Metal Wks., Inc., Chelsea, Mass.
Walworth Co., New York, N. Y.
Ward Foundries, Inc., J. P., Blossburgh, Pa.

FITTINGS, PIPE, BRASS, WELDING

Bonney Forge & Tool Wks., Allentown, Pa.
●Midwest Piping & Supply Co., Inc., St. Louis, Mo.
Tube-Turns, Louisville, Ky.

FITTINGS, PIPE, BRONZE, BRAZED

Crane Co., Chicago, Ill.
Flagg & Co., Inc., Stanley G., Philadelphia, Pa.
Walworth Co., New York, N. Y.

FITTINGS, PIPE, CAST IRON, FLANGED

American Cast Iron Pipe Co., Birmingham, Ala.
Central Foundry Co., New York, N. Y.
Clow & Sons, James B., Chicago, Ill.
Crane Co., Chicago, Ill.
Devine Mfg. Co., Inc., J. P., Mt. Vernon, Ill.
Eastern Foundry Co., Boyertown, Pa.
●Frick Co., Waynesboro, Pa.
●Grinnell Co., Inc., Providence, R. I.
Illinois Malleable Iron Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Kuhns Bros. Co., Dayton, O.
Lumsden & Van Stone Co., South Boston, Mass.
Lynchburg Foundry Co., Lynchburg, Va.
National Valve & Mfg. Co., Pittsburgh, Pa.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Semler Co., Jeannette, Pa.
Somerville Iron Works, Somerville, N. J.
Stockham Pipe Fittings Co., Birmingham, Ala.
Walworth Co., New York, N. Y.
Warren Foundry & Pipe Corp., New York, N. Y.

FITTINGS, PIPE, CAST IRON, THREADED

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Central Foundry Co., New York, N. Y.
Clow & Sons, James B., Chicago, Ill.
Crane Co., Chicago, Ill.
Detroit Brass & Malleable Wks., Detroit, Mich.
Devine Mfg. Co., Inc., J. P., Mt. Vernon, Ill.
●Devlin Mfg. Co., Inc., Thos., Burlington, N. J.
Eastern Foundry Co., Boyertown, Pa.
Flagg & Co., Inc., Stanley G., Philadelphia, Pa.
Grabler Mfg. Co., Cleveland, O.
●Grinnell Co., Inc., Providence, R. I.
Illinois Malleable Iron Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Kuhns Bros. Co., Dayton, O.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Ravena Iron Co., Ravena, N. Y.
Semler Co., Jeannette, Pa.
Somerville Iron Works, Somerville, N. J.
Stockham Pipe Fittings Co., Birmingham, Ala.
Walworth Co., New York, N. Y.
Ward Foundries, Inc., J. P., Blossburgh, Pa.

FITTINGS, PIPE, LEAD

Alpha Metal & Rolling Mills, Inc., Brooklyn, N. Y.
Andrews Lead Co., Inc., Long Island City, N. Y.
Eagle-Picher Lead Co., Cincinnati, O.
Flemm Lead Co., Inc., Long Island City, N. Y.
Lead Lined Iron Pipe Co., Wakefield, Mass.
Lissberger & Son., Inc., Marks, Long Island City, N. Y.
National Lead Co., New York, N. Y.

FITTINGS, PIPE, MALLEABLE

Crane Co., Chicago, Ill.
Detroit Brass & Malleable Wks., Detroit, Mich.
●Devlin Mfg. Co., Inc., Thos., Burlington, N. J.
Dresser Mfg. Co., Bradford, Pa.
Flagg & Co., Inc., Stanley G., Philadelphia, Pa.
General Fittings Co., Providence, R. I.
Grabler Mfg. Co., Cleveland, O.
●Grinnell Co., Inc., Providence, R. I.
Illinois Malleable Iron Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Jefferson Union Co., Lexington, Mass.
Kennedy Valve Mfg. Co., Elmira, N. Y.
●Malleable Iron Fittings Co., Branford, Conn.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Rhode Island Fittings Co., Hillsgrove, R. I.
Stockham Pipe Fittings Co., Birmingham, Ala.
Walworth Co., New York, N. Y.
Ward Foundries, Inc., J. P., Blossburgh, Pa.

FITTINGS, PIPE, STEEL, FLANGED

Alloy Steel Products Co., Linden, N. J. (Stainless steel).
●American Rolling Mill Co., The, Middletown, O.
Crane Co., Chicago, Ill.
National Valve & Mfg. Co., Pittsburgh, Pa.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Semet-Solvay Engrg. Corp., New York, N. Y.
Taylor Forge & Pipe Wks., Chicago, Ill.
Vogt Machine Co., Henry, Louisville, Ky.
Walworth Co., New York, N. Y.
●Watson-Stillman Co., Roselle, N. J.

FITTINGS, PIPE, STEEL, FORGED, THREADED

Crane Co., Chicago, Ill.
●Grinnell Co., Inc., Providence, R. I.
Taylor Forge & Pipe Wks., Chicago, Ill.
Vogt Machine Co., Henry, Louisville, Ky.
Walworth Co., New York, N. Y.
●Watson-Stillman Co., Roselle, N. J.

FITTINGS, PIPE, STEEL, SOCKET WELD

Crane Co., Chicago, Ill.
●Grinnell Co., Inc., Providence, R. I.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Vogt Machine Co., Henry, Louisville, Ky.
Walworth Co., New York, N. Y.
●Watson-Stillman Co., Roselle, N. J.

FITTINGS, PIPE, STEEL, THREADED

Alloy Steel Products Co., Linden, N. J. (Stainless steel).
Central Forging Co., Catawissa, Pa.
Crane Co., Chicago, Ill.
●Devlin Mfg. Co., Thos., Burlington, N. J.
Harrisburg Steel Corp., Harrisburg, Pa.
Penn Mfg. Corp. of Washington, Pa., Washington, Pa.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Vogt Machine Co., Henry, Louisville, Ky.
Walworth Co., New York, N. Y.
●Watson-Stillman Co., Roselle, N. J.

FITTINGS, PIPE, STEEL, WELDING

●American Rolling Mill Co., The, Middletown, O.
Bonney Forge & Tool Wks., Allentown, Pa.
Central Forging Co., Catawissa, Pa.
Crane Co., Chicago, Ill.
●Grinnell Co., Inc., Providence, R. I.
Larkin Packer Co., St. Louis, Mo.

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●Midwest Piping & Supply Co., Inc., St. Louis, Mo.
National Valve & Mfg. Co., Pittsburgh, Pa.
Oil Well Supply Co., Oil City, Pa.
Penn Mfg. Corp. of Washington, Pa., Washington, Pa.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Semet-Solvay Engineering Corp., New York, N. Y.
Taylor Forge & Pipe Wks., Chicago, Ill.
Tube-Turns, Louisville, Ky.
Vogt Machine Co., Henry, Louisville, Ky.
Walworth Co., New York, N. Y.
Wedge Protectors, Inc., Cleveland, O. (Chill rings)

FITTINGS, PIPE, WROUGHT IRON, WELDING

Bonney Forge & Tool Wks., Allentown, Pa.
●Grinnell Co., Inc., Providence, R. I.
●Midwest Piping & Supply Co., Inc., St. Louis, Mo.
National Valve & Mfg. Co., Pittsburgh, Pa.
Penn Mfg. Corp. of Washington, Pa., Washington, Pa.
Taylor Forge & Pipe Wks., Chicago, Ill.
Tube-Turns, Louisville, Ky.
Walworth Co., New York, N. Y.

FITTINGS, REFRIGERATION

American Injector Co., Detroit, Mich.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Commonwealth Brass Corp., Detroit, Mich.
Crane Co., Chicago, Ill.
●Frick Co., Waynesboro, Pa.
●Henry Valve Co., Chicago, Ill.
Imperial Brass Mfg. Co., Chicago, Ill.
Kerotest Mfg. Co., Pittsburgh, Pa.
●Mueller Brass Co., Port Huron, Mich.
Northern Indiana Brass Co., Elkhart, Ind.
Parker Appliance Co., Cleveland, O.
Perfection Refrigeration Parts Co., Harvey, Ill.
Superior Valve and Fittings Co., Pittsburgh, Pa.
Triumph Ice Machine Co., Cincinnati, O.
●Vilter Mfg. Co., Milwaukee, Wis.
Vogt Machine Co., Henry, Louisville, Ky.
Walworth Co., New York, N. Y.
●Watson-Stillman Co., Roselle, N. J.
Weatherhead Co., Cleveland, O.
Wittenmeier Machinery Co., Chicago, Ill.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
X L Refrigerating Co., Inc., Chicago, Ill.
●York Ice Machinery Corp., York, Pa.

FLANGE BOLTS

See Bolts and Studs, Flange

FLANGES, PIPE

●American Rolling Mill Co., The, Middletown, O.
Clow & Sons, James B., Chicago, Ill.
Crane Co., Chicago, Ill.
●Dart Mfg. Co., E. M., Providence, R. I.
●Devlin Mfg Co., Thos., Burlington, N. J.
Flagg & Co., Inc., Stanley G., Philadelphia, Pa.
Grabler Mfg. Co., Cleveland, O.
●Grinnell Co., Inc., Providence, R. I.
Harrisburg Steel Corp., Harrisburg, Pa.
Illinois Malleable Iron Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Jenkins Mfg. Co., New York, N. Y. (Brass only)
Kennedy Valve Mfg. Co., Elmira, N. Y.
Kuhns Bros. Co., Dayton, O.
Limbert & Co., Geo. B, Chicago, Ill.
Lumsden & Van Stone Co., South Boston, Mass.
Lynchburg Foundry Co., Lynchburg, Va.
●Midwest Piping & Supply Co., Inc., St. Louis, Mo.
National Valve & Mfg. Co., Pittsburgh, Pa.
Naylor Pipe Co., Chicago, Ill.
Pennsylvania Forge Co., Philadelphia, Pa.
Pittsburgh Piping & Equipment Co., Pittsburgh, Pa.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Power Piping Div., Blaw-Knox Co., Pittsburgh, Pa.
Ravena Iron Co., Ravena, N. Y.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Rhode Island Fittings Co., Hillsgrove, R. I.
Semler Co., Jeannette, Pa.
Steel Improvement & Forge Co., Cleveland, O.
Stokes Rubber Co., Jos., Trenton, N. J. (Hard rubber)
Taylor Forge & Pipe Wks., Chicago, Ill.
Tube-Turns, Louisville, Ky.
Vogt Machine Co., Henry, Louisville, Ky.
Walworth Co., New York, N. Y.
Ward Foundries, Inc., J. P., Blossburgh, Pa.
Warren Foundry & Pipe Corp., New York, N. Y.
X L Refrigerating Co., Inc., Chicago, Ill.

FLEXIBLE COUPLINGS

See Couplings, Flexible

FLEXIBLE DUCT CONNECTIONS

See Connections, Duct, Flexible

FLEXIBLE METAL HOSE

See Hose, Metal, for Eliminating Compressor Vibration

FLOAT SWITCHES

See Switches, Float

FLOAT VALVES

See Valves, Float

FLOATS, STEAM TRAP, ETC.

Clark Controller Co., Cleveland, O.
Cryer Trap & Valve Co., Inc., New York, N. Y.
d'Este Co., Julian, Charlestown, Mass.
Fisher Governor Co., Marshalltown, Ia.
Harris & Co., Arthur, Chicago, Ill.
Hercules Float Wks., Springfield, Mass.
Hoffman Specialty Co., Inc., Waterbury, Conn.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
McAlear Mfg. Co., Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Naugatuck Mfg. Co., Union City, Conn.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Reichert Float & Mfg. Co., Toledo, O.
Reliance Gauge Column Co., Cleveland, O.
Sterling Engineering Co., Milwaukee, Wis.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
●Trane Co., LaCrosse, Wis.
Vapor Specialty Co., New York, N. Y.
Watson & McDaniel Co., Philadelphia, Pa.
Williams Gauge Co., Pittsburgh, Pa.
Wright-Austin Co., Detroit, Mich.

FLOOR AND CEILING PLATES

See Plates, Floor and Ceiling

FLOW METERS

See Meters, Flow

FORGED STEEL VALVES

See Valves, Forged Steel

FURNACES, WARM AIR, FOR INDUSTRIAL AND LARGE BUILDING HEATING

Acme Heating & Ventilating Co., Inc., Chicago, Ill.
American Foundry & Furnace Co., Bloomington, Ill.
Arcweld Mfg. Co., Inc., Seattle, Wash.
Atlas Heating & Ventilating Co., Ltd., San Francisco, Cal.
Campbell Heating Co., Des Moines, Ia.
Campbell Heating Co., E. K., Kansas City, Mo.
Dail Steel Products Co., Lansing, Mich.
Forest City Foundries Co., Cleveland, O.
Jackson & Church Co., Saginaw, Mich.
Lee Engineering Co., Youngstown, O.
Lennox Furnace Co., Marshalltown, Ia., and Syracuse, N. Y.
Magirl Foundry & Furnace Wks., P. H., Bloomington, Ill.
Majestic Co., Huntington, Ind.
McCann Furnace Co., Cleveland, O.
McPherson Furnace & Supply Co., Portland, Ore.
Moncrief Furnace Co., Atlanta, Ga.
Montag Stove & Furnace Wks., Portland, Ore.
Mueller Furnace Co., L. J., Milwaukee, Wis.
New York Blower Co., Chicago, Ill.
Rosebraugh Co., W. W., Salem, Ore.
Western Furnaces, Inc., Tacoma, Wash.
XXth Century Heating & Ventilating Co., Akron, O.
Zink Co., John, Tulsa, Okla.

GAGES, AIR FILTER

●Air Filter Engineering Co., Chicago, Ill.
●American Air Filter Co., Inc., Louisville, Ky. (Whistling device)
Detroit Air Meter Co., Detroit, Mich.
Ellison Draft Gage Co., Chicago, Ill.
Friez & Sons, Julien P., Baltimore, Md.
Hays Corp., Michigan City, Ind.
Herbusch Corp., The, St. Louis, Mo. (Warning device)
Hill, E. Vernon, Chicago, Ill.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
●Meriam Co., The, Cleveland, O.

GAGES, INDICATING, DRAFT

Bacharach Industrial Instrument Co., Pittsburgh, Pa.
Bailey Meter Co., Cleveland, O.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Crew-Equipment Co., Inc., New York, N. Y.
Defender Automatic Regulator Co., St. Louis, Mo.
Detroit Air Meter Co., Detroit, Mich.
Dwyer Mfg. Co., F. W., Chicago, Ill.
Ellison Draft Gage Co., Chicago, Ill.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
Hays Corp., Michigan City, Ind.
Hill, E. Vernon, Chicago, Ill.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
Leeds & Northrup Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., Ashcroft American Gauge Div., Bridgeport, Conn.
●Meriam Co., The, Cleveland, O.
Moeller Instrument Co., Richmond Hill, N. Y.
Precision Thermometer & Instrument Co., Philadelphia, Pa.

Preferred Utilities Mfg. Co., New York, N. Y.
Republic Flow Meters Co., Chicago, Ill.
Scientific Instrument Co., Detroit, Mich.
Spence Engrg. Co., Inc., Walden, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Uehling Instrument Co., Paterson, N. J.

GAGES, INDICATING, PRESSURE

Ashton Valve Co., Cambridge, Mass.
Bacharach Industrial Instrument Co., Pittsburgh, Pa.
Bailey Meter Co., Cleveland, O.
Barnes & Jones, Inc., Jamaica Plain, Boston, Mass.
Belfield Co., H., Philadelphia, Pa.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Builders Iron Foundry, Providence, R. I.
Defender Automatic Regulator Co., St. Louis, Mo.
Detroit Brass & Malleable Wks., Detroit, Mich.
●Dunham Co., C. A., Chicago, Ill.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
Hays Corp., Michigan City, Ind.
Hill, E. Vernon, Chicago, Ill.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
Lonergan Co., J. E., Philadelphia, Pa.
Marsh Corp., Jas. P., Chicago, Ill.
Mercoid Corp., Chicago, Ill.
●Meriam Co., The, Cleveland, O.
Moeller Instrument Co., Richmond Hill, N. Y.
Mouat Vapor Heating Co., The, Cleveland, O.
Pierce, Butler Radiator Corp., Syracuse, N. Y.
Precision Thermometer & Instrument Co., Philadelphia, Pa.
Republic Flow Meters Co., Chicago, Ill.
Rochester Mfg. Co., Rochester, N. Y.
Scientific Instrument Co., Detroit, Mich.
Sterling Engineering Co., Milwaukee, Wis.
Taylor Instrument Companies, Rochester, N. Y.
Uehling Instrument Co., Paterson, N. J.
United States Gauge Co., New York, N. Y.

GAGES, INDICATING, VACUUM

Ashton Valve Co., Cambridge, Mass.
Bacharach Industrial Instrument Co., Pittsburgh, Pa.
Bailey Meter Co., Cleveland, O.
Barnes & Jones, Inc., Jamaica Plain, Boston, Mass.
Belfield Co., H., Philadelphia, Pa.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Defender Automatic Regulator Co., St. Louis, Mo.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
Hoffman Specialty Co., Inc., Waterbury, Conn.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
Lonergan Co., J. E., Philadelphia, Pa.
Marsh Corp., Jas. P., Chicago, Ill.
Mercoid Corp., Chicago, Ill.
●Meriam Co., The, Cleveland, O.
Moeller Instrument Co., Richmond Hill, N. Y.
Mouat Vapor Heating Co., The, Cleveland, O.
Precision Thermometer & Instrument Co., Philadelphia, Pa.
Republic Flow Meters Co., Chicago, Ill.
Rochester Mfg. Co., Rochester, N. Y.
Scientific Instrument Co., Detroit, Mich.
Sterling Engineering Co., Milwaukee, Wis.
Taylor Instrument Companies, Rochester, N. Y.
Uehling Instrument Co., Paterson, N. J.
United States Gauge Co., New York, N. Y.

GAGES, LIQUID LEVEL

Bacharach Industrial Instrument Co., Pittsburgh, Pa.
Bordo Co., Inc., L. J., Glenside, Pa.
Boston Auto Gage Co., Pittsfield, Mass.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Caldwell Co., W. E., Louisville, Ky.
Defender Automatic Regulator Co., St. Louis, Mo.
Detroit Lubricator Co., Detroit, Mich.
Diamond Power Specialty Corp., Detroit, Mich.
Foxboro Co.. Foxboro, Mass.
Hays Corp., Michigan City, Ind.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
Keckley Co., O. C., Chicago, Ill.
King Engineering Corp., Ann Arbor, Mich.
Klingerit, Inc., New York, N. Y.
Liquidometer Corp., Long Island City, N. Y.
Lonergan Co., J. E., Philadelphia, Pa.
●Meriam Co., The, Cleveland, O.
Nason Co., Detroit, Mich.
Petrometer Corp., Long Island City, N. Y.
Powell Co., Wm., Cincinnati, O.
Precision Thermometer & Instrument Co., Philadelphia, Pa.
Reliance Gauge Column Co., Cleveland, O.
Republic Flow Meters Co., Chicago, Ill.
Rochester Mfg. Co., Rochester, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
Scientific Instrument Co., Detroit, Mich.
Taylor Instrument Companies, Rochester, N. Y.
Uehling Instrument Co., Paterson, N. J.
United States Gauge Co., New York, N. Y.
Viking Pump Co., Cedar Falls, Ia.
Wright-Austin Co., Detroit, Mich.
●Yarnall-Waring Co., Philadelphia, Pa.

GALVANIZED SHEETS

See Sheets, Steel, Galvanized

GALVANNEALED SHEETS

See Sheets, Steel, Galvannealed

GAS BURNERS

See Burners, Gas

GAS ENGINES

See Engines, Gas

GAS PRESSURE REGULATORS

See Regulators, Pressure, Gas

GASKETS

Akron Metallic Gasket Co., Akron, O. (Metal & metal asbestos)
Alpha Metal & Rolling Mills, Inc., Brooklyn, N. Y.
Anchor Packing Co., Philadelphia, Pa. (Asbestos)
●Armstrong Cork Co., Lancaster, Pa. (Cork & cork composition)
Azor Corp., Newark, N. J. (Spiral wound)
Butterworth, Jr., B. T., New Canaan, Conn. (Cork)
Chicago-Wilcox Mfg. Co., Chicago, Ill.
Clow & Sons, James B., Chicago, Ill.
Continental Diamond Fibre Co., Newark, Del.
Continental Rubber Wks., Erie, Pa.
Crane Co., Chicago, Ill.
Crane Packing Co., Chicago, Ill.
Darcoid Co., Inc., New York, N. Y. (Asbestos)
Durabla Mfg. Co., New York, N. Y. (Asbestos fibre)
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Endura Mfg. Corp., Quakertown, Pa. (Paper, fibre)
Excelsior Leather Washer Co., Rockford, Ill.
Felt Products Mfg. Co., Chicago, Ill. (Heat and oil resisting)
Flexatalic Gasket Co., Camden, N. J. (Metal, asbestos)
Garlock Packing Co., Palmyra, N. Y. (Rubber, asbestos, fibre, semi-metallic)
Gatke Corp., Chicago, Ill.
Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.
Goodrich Co., B. F., Akron, O. (Rubber, asbestos, synthetics)
Graton & Knight Co., Worcester, Mass. (Leather)
Houghton & Co., E. F., Philadelphia, Pa. (Leather)
Jenkins Bros., New York, N. Y. (Ring asbestos or rubber sheet)
Johns-Manville, New York, N. Y.
Keasbey & Mattison Co., Ambler, Pa. (Asbestos)
Klingerit, Inc., New York, N. Y.
Manhattan Rubber Mfg., Div. of Raybestos-Manhattan, Inc., Passaic, N. J.
Metallo Gasket Co., New Brunswick, N. J. (Metal, metal asbestos)
Miller Rubber Co., Inc., Akron, O.
Mitchell & Smith, Inc., Detroit, Mich. (Cork)
Pacific States Felt & Mfg. Co., Inc., San Francisco, Cal.
Resistoflex Corp., Belleville, N. J. (Synthetic resin)
Ruberoid Co., New York, N. Y. (Asbestos)
Smooth-On Mfg. Co., Jersey City, N. J. (Corrugated iron)
Steel Improvement & Forge Co., Cleveland, O.
Stokes Rubber Co., Jos., Trenton, N. J. (Hard rubber)
Union Asbestos & Rubber Co., Cicero, Ill.
United States Rubber Co., New York, N. Y. (Rubber, asbestos)
Western Felt Wks., Chicago, Ill. (Felt)
Wills Gasket, Ltd., New Bedford, Mass.
●Wilson, Inc., Grant, Chicago, Ill. (Asbestos)

GATE VALVES

See Valves, Gate

GLASS PIPE

See Pipe, Glass

GLOBE VALVES

See Valves, Globe

GOVERNORS, PUMP

Atlas Valve Co., Inc., Newark, N. J.
Bailey Meter Co., Cleveland, O.
Boylston Steam Specialty Co., Chicago, Ill.
Burrows Mfg. Co., F. A., York, Pa.
●Cash Co., A. W., Decatur, Ill.
Davis Regulator Co., Chicago, Ill.
Defender Automatic Regulator Co., St. Louis, Mo.
d'Este Co., Julian, Charlestown, Mass.
Fisher Governor Co., Marshalltown, Ia.
Foster Engineering Co., Newark, N. J.
Gardner-Denver Co., Quincy, Ill.
●Illinois Engineering Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Keckley Co., O. C., Chicago, Ill.
Kieley & Mueller, Inc., New York, N. Y.
Klipfel Mfg. Co., Chicago, Ill.
Leslie Co., Lyndhurst, N. J.
Locke Regulator Co., Salem, Mass.
Mason-Neilan Regulator Co., Boston, Mass.
McAlear Mfg. Co., Chicago, Ill.
Mueller Co., Decatur, Ill.

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Mueller Steam Specialty Co., Inc., New York, N. Y.
Northern Equipment Co., Erie, Pa.
Ruggles-Klingemann Mfg. Co., Salem, Mass.
Schade Valve Mfg. Co., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Squires Co., C. E., Cleveland, O.
Staples & Pfeiffer, Ltd., San Francisco, Cal.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Swartwout Co., Cleveland, O.
Watson & McDaniel Co., Philadelphia, Pa.
Watts Regulator Co., Lawrence, Mass.
●Webster & Co., Warren, Camden, N. J.
Williams Gauge Co., Pittsburgh, Pa.
Wright-Austin Co., Detroit, Mich.

GRILLES

Air Control Products, Inc., Muskegon, Mich.
Aircraft Mfg. Co., Dayton, O.
American Foundry & Furnace Co., Bloomington, Ill.
American Warming & Ventilating Co., Toledo, O.
●Auer Register Co., Cleveland, O.
●Barber-Colman Co., Rockford, Ill.
Beckley Perforating Co., Garwood, N. J.
Best Register Co., Milwaukee, Wis.
Central Wire & Iron Works, Des Moines, Ia.
Chicago Perforating Co., Chicago, Ill.
Cincinnati Mfg. Co., Cincinnati, O.
Char-Gale Mfg. Co., Minneapolis, Minn.
Cross Engineering Co., Carbondale, Pa.
Crown Iron Works, Minneapolis, Minn.
Decatur Iron & Steel Co., Decatur, Ala.
Diamond Mfg. Co., Wyoming, Pa.
Eckenroth Register Co., San Francisco, Cal.
Erdle Perforating Co., Rochester, N. Y.
Falstrom Co., Passaic, N. J.
Gillian Mfg. Co., Ferndale, Mich.
Globe Machine & Stamping Co., Cleveland, O.
Harrington & King Perforating Co., Chicago, Ill.
Hart & Cooley Mfg. Co., Chicago, Ill.
Hendrick Mfg. Co., Carbondale, Pa.
●Independent Register Co., Cleveland, O.
Lamneck Products, Inc., Columbus, O.
Manhattan Perforated Metal Co., Inc., Long Island City, N. Y.
Metalace Corp., So. Boston, Mass.
Mueller Furnace Co., L. J., Milwaukee, Wis.
Mundt & Sons, Charles, Jersey City, N. J.
Newman Brothers, Inc., Cincinnati, O.
Register & Grille Mfg. Co., Brooklyn, N. Y.
Reliable Perforating Co., Chicago, Ill.
Roberts-Hamilton Co., Minneapolis, Minn.
Rock Island Register Co., Rock Island, Ill.
●Trane Co., La Crosse, Wis.
●Tuttle & Bailey, Inc., New Britain, Conn.
●U. S. Air Conditioning Corp., Minneapolis, Minn.
United States Register Co., Battle Creek, Mich.
●Waterloo Register Co., Waterloo, Ia.
Western Wire & Iron Works, Inc., Chicago, Ill.
Wickwire Spencer Steel Co., New York, N. Y.

GUNS AND POTS, SMOKE AND SMUDGE, FOR TESTING AIR MOVEMENT

Hill, E. Vernon, Chicago, Ill.
Newman Co., Inc., I. C., New York, N. Y.
Pains Fireworks Display Co., New York, N. Y.

HAND SHEARS

See Shears and Snips, Hand

HANGERS OR BRACKETS, RADIATOR

American Foundry & Furnace Co., Bloomington, Ill.
American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Carpenter & Paterson, Inc., East Boston, Mass.
Carty & Moore Engineering Co., Detroit, Mich.
Chicago Nipple Mfg. Co., Chicago, Ill.
Crane Co., Chicago, Ill.
Crawford Co., Chicago, Ill.
Fee & Mason Mfg. Co., Inc., New York, N. Y.
Grabler Mfg. Co., Cleveland, O.
●Grinnell Co., Inc., Providence, R. I.
Hartmann Co., Chas., Brooklyn, N. Y.
Healy Ruff Co., St. Paul, Minn.
Inland Mfg. Co., Chicago, Ill. (Unit heater hangers)
Jennison Co., Fitchburg, Mass. (Adjustable radiator foot rest)
Logansport Radiator Equipment Co., Logansport, Ind.
McAlear Mfg. Co., Chicago, Ill.
National Radiator Co., The, Johnstown, Pa.
Paine Co., Chicago, Ill.
Pierce, Butler Radiator Corp., Syracuse, N. Y.
Richmond Radiator Co., Gas Products Div., Uniontown, Pa.
Sterling Engineering Co., Milwaukee, Wis.
United States Radiator Corp., Detroit, Mich.
Western Hanger Co., San Francisco, Cal.

HANGERS AND SUPPORTS, PIPE

●American District Steam Co., North Tonawanda, N. Y.
American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Beaton & Cadwell Mfg. Co., New Britain, Conn.
Carpenter & Paterson, Inc., East Boston, Mass.
Chicago Nipple Mfg. Co., Chicago, Ill.
Crane Co., Chicago, Ill.
Crawford Co., Chicago, Ill.
●Devlin Mfg. Co., Inc., Thos., Burlington, N. J.
Farley Sleeve & Hanger Co., Cleveland, O.
Fee & Mason Mfg. Co., Inc., New York, N. Y.
Globe Machine & Stamping Co., Cleveland, O.
Grabler Mfg. Co., Cleveland, O.
●Grinnell Co., Inc., Providence, R. I.
Illinois Malleable Iron Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Lumsden & Van Stone Co., South Boston, Mass.
●Midwest Piping & Supply Co., Inc., St. Louis, Mo.
National Valve & Mfg. Co., Pittsburgh, Pa.
Paine Co., Chicago, Ill.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Ravena Iron Co., Ravena, N. Y.
Reznor Mfg. Co., Mercer, Pa.
●Ric-wiL Co., Cleveland, O. (Underground)
Rockwood Sprinkler Co., Worcester, Mass.
Roessing Mfg. Co., Pittsburgh, Pa.
Semler Co., Jeannette, Pa.
Walworth Co., New York, N. Y.
Ward Foundries, Inc., J. P., Blossburg, Pa.
Western Wire Products Co., St. Louis, Mo.

HARD RUBBER PIPE

See Pipe and Fittings, Hard Rubber

HEADERS, WELDED

Acme Industries, Inc., Jackson, Mich.
●Baker Ice Machine Co., Inc., Omaha, Neb.
Chicago Nipple Mfg. Co., Chicago, Ill.
Columbian Steel Tank Co., Kansas City, Mo.
Crane Co., Chicago, Ill.
●Grinnell Co., Inc., Providence, R. I.
International Engineering Wks., Inc., Framingham, Mass.
Kellogg Co., M. W., The, New York, N. Y.
Limbert & Co., Geo. B., Chicago, Ill.
Lumsden & Van Stone Co., South Boston, Mass.
●Midwest Piping & Supply Co., Inc., St. Louis, Mo.
National Pipe Bending Co., New Haven, Conn.
National Valve & Mfg. Co., Pittsburgh, Pa.
Naylor Pipe Co., Chicago, Ill.
Ohio Pipe Bending & Mach. Co., Cleveland, O.
Philadelphia Pipe Bending Co., Philadelphia, Pa.
Pittsburgh Pipe Coil & Bending Co., Etna, Pa.
Pittsburgh Piping & Equipment Co., Pittsburgh, Pa.
Power Piping Div., Blaw-Knox Co., Pittsburgh, Pa.
●Rempe Co., Chicago, Ill.
Roessing Mfg. Co., Pittsburgh, Pa.
Sales & Co., Murray W., Detroit, Mich.
Semet-Solvay Engineering Corp., New York, N. Y.
Shaw Co., Benjamin F., Wilmington, Del.
Shaw-Kendall Engineering Co., Toledo, O.
Walworth Co., New York, N. Y.
X L Refrigerating Co., Chicago, Ill.

HEADS, SPRINKLER

Binks Mfg. Co., Chicago, Ill.
Cleghorn Co., Boston, Mass.
●Grinnell Co., Inc., Providence, R. I.
Hodgman Mfg. Co., Taunton, Mass.
Northern Indiana Brass Co., Elkhart, Ind.
Raisler Sprinkler Co., New York, N. Y.
Rockwood Sprinkler Co., Worcester, Mass.
Ross Sprinkler Co., Pasadena, Cal.

HEAT EXCHANGERS

See Chillers, Water; Condensers, Refrigerating; Surface, Cooling; Surface, Heating

HEATERS, AIR, DIRECT FIRED

●Airtherm Mfg. Co., St. Louis, Mo.
Despatch Oven Co., Minneapolis, Minn.
Dravo Corp., Pittsburgh, Pa.
Grand Rapids Blow Pipe & Dust Arrester Co., Grand Rapids, Mich.
Jackson & Church Co., Saginaw, Mich.
Lee Engineering Co., Youngstown, O.
Magirl Foundry & Furnace Wks., P. H., Bloomington, Ill.
McCann Furnace Co., Cleveland, O.
Nelson Co., Detroit, Mich.
New York Blower Co., Chicago, Ill.
Reznor Mfg. Co., Mercer, Pa.
Ross Engineering Corp., J. O., New York, N. Y.
Smith, Inc., James Campbell, Cleveland, O.
Supreme Heater & Ventilating Corp., St. Louis, Mo.
Surface Combustion Corp., Toledo, O.
Williams, Inc., F. C., Dearborn, Mich.

HEATERS, DUCT, ELECTRIC

General Electric Co., Schenectady, N. Y.
Hynes Electric Heating Co., Philadelphia, Pa.
Trent Co., Harold E., Philadelphia, Pa.
●Wiegand Co., Edwin L., Pittsburgh, Pa.

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HEATERS, DUCT, GAS

Bryant Heater Co., The, Cleveland, O.
Pacific Gas Radiator Co., Huntington Park, Cal.
Utility Fan Corp., Los Angeles, Cal.

HEATERS, STRIP AND IMMERSION, ELECTRIC

American Instrument Co., Silver Spring, Md.
Cutler-Hammer, Inc., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Hynes Electric Heating Co., Philadelphia, Pa.
Red Spot Electric Co., Tacoma, Wash.
Trent Co., Harold E., Philadelphia, Pa.
Vulcan Electric Co., Lynn, Mass.
●Westinghouse Electric & Mfg. Co., Mansfield, O.
●Wiegand Co., Edwin L., Pittsburgh, Pa.

HEATERS, UNIT, ELECTRIC HEATING ELEMENT

●Burnham Boiler Corp., Irvington, N. Y. (Radiator)
Electric Air Heater Co., Div. American Foundry Equipment Co., Mishawaka, Ind.
Hynes Electric Heating Co., Philadelphia, Pa.
Ilg Electric Ventilating Co., Chicago, Ill.
Red Spot Electric Co., Tacoma, Wash.
Samson-United Corp., Rochester, N. Y.
Trent Co., Harold E., Philadelphia, Pa.
Vulcan Electric Co., Lynn, Mass.
Warren Electric Appliance Co., Warren, Pa.
●Westinghouse Electric & Mfg. Co., Mansfield, O.
●Wiegand Co., Edwin L., Pittsburgh, Pa.

HEATERS, UNIT, GAS FIRED

Automatic Gas Steam Radiator Co., Pittsburgh, Pa.
Bryant Heater Co., The, Cleveland, O.
●Buffalo Forge Co., Buffalo, N. Y.
Campbell Heating Co., E. K., Kansas City, Mo.
●Carrier Corp., Syracuse, N. Y.
Continental Stove Corp., Ironton, O.
General Gas Light Co., Kalamazoo, Mich.
●McCord Radiator & Mfg. Co., Detroit, Mich.
Mueller Furnace Co., L. J., Milwaukee, Wis.
Pacific Gas Radiator Co., Huntington Park, Cal.
Reznor Mfg. Co., Mercer, Pa.
Ross Engineering Corp., J. O., New York, N. Y.
Schoedinger, F. O., Columbus, O.
Surface Combustion Corp., Toledo, O.
●Trane Co., La Crosse, Wis.
Utility Fan Corp., Los Angeles, Cal.

HEATERS, UNIT, STEAM AND HOT WATER

●Airtherm Mfg. Co., St. Louis, Mo.
American Blower Corp., Detroit, Mich.
●Autovent Fan & Blower Co., Chicago, Ill.
Bayley Blower Co., Milwaukee, Wis.
Beacon-Morris Corp., Boston, Mass.
Berns Specialty Co., Chicago, Ill.
●Bishop & Babcock Mfg. Co., Cleveland, O.
Blower Application Co., Milwaukee, Wis.
●Buffalo Forge Co., Buffalo, N. Y.
●Burnham Boiler Corp., Irvington, N. Y.
Campbell Heating Co., E. K., Kansas City, Mo.
●Carrier Corp., Syracuse, N. Y.
●Clarage Fan Co., Kalamazoo, Mich.
Drayer & Hanson, Inc., Los Angeles, Cal.
●Dunham Co., C. A., Chicago, Ill.
Economy Electric Mfg. Co., Chicago, Ill.
Electrovent Fan & Mfg. Co., Chicago, Ill.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.
●Grinnell Co., Inc., Providence, R. I.
Hartzell Propeller Fan Co., Piqua, O.
Hastings Air Conditioning Co., Hastings, Neb.
Ilg Electric Ventilating Co., Chicago, Ill.
●Industrial Mfg. & Engrg. Co., Chicago, Ill.
Jaden Mfg. Co., Inc., F., Hastings, Neb.
Johnson Fan & Blower Corp., Chicago, Ill.
King Ventilating Co., Owatonna, Minn.
Kisco Boiler & Engineering Co., St. Louis, Mo.
Kramer Trenton Co., Trenton, N. J.
●McCord Radiator & Mfg. Co., Detroit, Mich.
●McQuay, Inc., Minneapolis, Minn.
Modine Mfg. Co., Racine, Wis.
Murray Iron Wks. Co., Burlington, Ia.
Murray Mfg. Co., D. J., Wausau, Wis.
National Radiator Co., The, Johnstown, Pa.
Nelson Corp., Herman, Moline, Ill.
●Nesbitt, Inc., John J., & Buckeye Blower Co., Philadelphia, Pa.
New York Blower Co., Chicago, Ill.
Niagara Blower Co., New York, N. Y.
Perfex Corp. (Unit Heater Div.), Milwaukee, Wis.
Richmond Engineering Co., Inc., Richmond, Va.
Rome-Turney Radiator Co., Rome, N. Y.
●St. Louis Blow Pipe & Heater Co., St. Louis, Mo.
●Sturtevant Co., B. F., Boston, Mass.
Super Radiator Corp., Minneapolis, Minn.
●Trane Co., La Crosse, Wis.
●U. S. Air Conditioning Corp., Minneapolis, Minn.
●Unit Heater & Cooler Co., Wausau, Wis.
●Webster & Co., Warren, Camden, N. J.
Western Blower Co., Seattle, Wash.
●Wing Mfg. Co., L. J., New York, N. Y.
●Young Radiator Co., Racine, Wis.

HEATERS, WATER, CAST IRON, COAL FIRED

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
●Burnham Boiler Corp., Irvington, N. Y.
Central Radiator Co., New York, N. Y.
Cleghorn Co., Boston, Mass.
Eastern Foundry Co., Peerless Heater Div., Boyertown, Pa.
Glore Sales Corp., Evins F., New York, N. Y.
Hart & Crouse Corp., Utica, N. Y.
International Heater Co., Utica, N. Y.
Mueller Furnace Co., L. J., Milwaukee, Wis.
National Pipe Bending Co., New Haven, Conn.
National Radiator Co., The, Johnstown, Pa.
Pierce, Butler Radiator Corp., Syracuse, N. Y.
Prox Co., Inc., Frank, Terre Haute, Ind.
Smith Co., Inc., H. B., The, Westfield, Mass.
Spencer Heater Div., Aviation Mfg. Corp., Williamsport, Pa.
Thatcher Furnace Co., Newark, N. J.
Weil-McLain Co., Chicago, Ill.

HEATERS, WATER, GAS FIRED

American Bosch Corp., Springfield, Mass.
American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Bryant Heater Co., The, Cleveland, O.
Crane Co., Chicago, Ill.
Dahlquist Mfg. Co., Inc., Boston, Mass.
●Dunham Co., C. A., Chicago, Ill.
Eastern Foundry Co., Peerless Heater Div., Boyertown, Pa.
Eclipse Fuel Engineering Co., Rockford, Ill.
Handley Brown Heater Co., Jackson, Mich.
Hotstream Heater Co., Cleveland, O.
International Engineering Wks., Inc., Framingham, Mass.
Johnson Co., S. T., Oakland, Cal.
Mueller Furnace Co., L. J., Milwaukee, Wis.
National Radiator Co., The, Johnstown, Pa.
Pacific Gas Radiator Co., Huntington Park, Cal.
Pittsburgh Water Heater Co., Pittsburgh, Pa.
Richmond Radiator Co., Uniontown, Pa.
Rotary Mfg. Co., Los Angeles, Cal.
Ruud Mfg. Co., Pittsburgh, Pa.
Schoedinger, F. O., Columbus, O.
Surface Combustion Corp., Toledo, O.
United States Radiator Corp., Detroit, Mich.

HEATERS, WATER, INDIRECT

Akwa Heaters, Inc., New York, N. Y.
●American District Steam Co., North Tonawanda, N. Y.
American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Atlantic Valve & Pump Co., Chicago, Ill.
Automatic Stoker Corp., Milwaukee, Wis.
●Bell & Gossett Co., Chicago, Ill.
Bryan Steam Corp., Peru, Ind.
Croll-Reynolds Engineering Co., Inc., New York, N. Y.
Davis Engineering Corp., Elizabeth, N. J.
d'Este Co., Julian, Charlestown, Mass.
Ferguson & Lange Foundry Co., Chicago, Ill.
Frank Heaters, Inc., Paterson, N. J.
General Fittings Co., Providence, R. I.
Hotstream Heater Co., Cleveland, O.
Kehm Corp., The, Chicago, Ill.
Koven & Bro., Inc., L. O., Jersey City, N. J.
Little Mfg. Co., M. S., Hartford, Conn.
Marion Machine Foundry & Supply Co., Marion, Ind.
National Pipe Bending Co., New Haven, Conn.
●Patterson-Kelley Co., Inc., East Stroudsburg, Pa.
Richmond Engineering Co., Inc., Richmond, Va.
Sterling Engineering Co., Milwaukee, Wis.
Taco Heaters, Inc., New York, N. Y.
Thrush & Co., H. A., Peru, Ind.
Vapor Car Heating Co., Inc., Chicago, Ill.
Watts Regulator Co., Lawrence, Mass.

HEATERS, WATER, OIL FIRED

Bethlehem Foundry & Machine Co., Bethlehem, Pa.
Delco Appliance Co., Rochester, N. Y.
Electrol, Inc., Clifton, N. J.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Glore Sales Corp., Evins F., New York, N. Y.
Hotstream Heater Co., Cleveland, O.
International Engineering Wks., Inc., Framingham, Mass.
Johnson Co., S. T., Oakland, Cal.
Littleford Bros., Cincinnati, O.
National Radiator Co., The, Johnstown, Pa.
Nu-Way Corp., Rock Island, Ill.
Pacific Steel Boiler Div., United States Radiator Corp., Detroit, Mich.
Ray Oil Burner Co., San Francisco, Cal.
Reif-Rexoil, Inc., Buffalo, N. Y.
Scott-Newcomb, Inc., St. Louis, Mo.
Smith Co., Inc., H. B., The, Westfield, Mass.
Spencer Heater Div., Aviation Mfg. Corp., Williamsport, Pa.
United States Radiator Corp., Detroit, Mich.
Vapor Car Heating Co., Inc., Chicago, Ill.

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Wayne Oil Burner Corp., Fort Wayne, Ind.
Williams Oil-O-Matic Heating Corp., Bloomington, Ill.
York Oil Burner Co., Inc., York, Pa.

HEATERS, WATER, STEAM, INSTANTANEOUS

Akwa Heaters, Inc., New York, N. Y.
●American District Steam Co., North Tonawanda, N. Y.
●Bell & Gossett Co., Chicago, Ill.
Croll-Reynolds Engineering Co., Inc., New York, N. Y.
Dahlquist Mfg. Co., Inc., Boston, Mass.
Davis Engineering Corp., Elizabeth, N. J.
Eclipse Fuel Engineering Co., Rockford, Ill.
Frank Heaters, Inc., Paterson, N. J.
General Fittings Co., Providence, R. I.
General Furnaces Corp., New York, N. Y.
Gerstein & Cooper Co., South Boston, Mass.
Griscom-Russell Co., The, New York, N. Y.
Hasco Valve & Machine Co., Milwaukee, Wis.
Howard Iron Wks. & Alberger Heater Co., Buffalo, N. Y.
Johnson Corp., Three Rivers, Mich.
Marion Machine Foundry & Supply Co., Marion, Ind.
National Pipe Bending Co., New Haven, Conn.
●Patterson-Kelley Co., Inc., East Stroudsburg, Pa.
Quaker City Iron Works, Philadelphia, Pa.
Richmond Engineering Co., Inc., Richmond, Va.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
Sims Co., Erie, Pa.
Sterling Engineering Co., Milwaukee, Wis.
Super Radiator Corp., Minneapolis, Minn.
Swartwout Co., Cleveland, O.
Taco Heaters, Inc., New York, N. Y.
Watts Regulator Co., Lawrence, Mass.
Whitlock Coil Pipe Co., Hartford, Conn.

HEATERS, WATER, STEAM, STORAGE

Akwa Heaters, Inc., New York, N. Y.
●American District Steam Co., North Tonawanda, N. Y.
●Bell & Gossett Co., Chicago, Ill.
Bigelow Co., New Haven, Conn.
Bros Boiler & Mfg. Co., Wm., Minneapolis, Minn.
●Burnham Boiler Corp., Irvington, N. Y.
Dahlquist Mfg. Co., Inc., Boston, Mass.
Davis Engineering Co., Elizabeth, N. J.
Frank Heaters, Inc., Paterson, N. J.
General Fittings Co., Providence, R. I.
Gerstein & Cooper Co., South Boston, Mass.
Griscom-Russell Co., The, New York, N. Y.
Howard Iron Wks. & Alberger Heater Co., Buffalo, N. Y.
Hynes Electric Heating Co., Philadelphia, Pa.
International Engineering Wks., Inc., Framingham, Mass.
Johnson Corp., Three Rivers, Mich.
●Kewanee Boiler Corp., Kewanee, Ill.
Koven & Bro., Inc., L. O., Jersey City, N. J.
Manitowoc Boiler Wks., Manitowoc, Wis.
Milwaukee Reliance Boiler Wks., Milwaukee, Wis.
National Pipe Bending Co., New Haven, Conn.
●Patterson-Kelley Co., Inc., East Stroudsburg, Pa.
Quaker City Iron Works, Philadelphia, Pa.
Richmond Engineering Co., Inc., Richmond, Va.
Rockwood Sprinkler Co., Worcester, Mass.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Rotary Mfg. Co., Los Angeles, Cal.
Sims Co., Erie, Pa.
Super Radiator Corp., Minneapolis, Minn.
Taco Heaters, Inc., New York, N. Y.
Vogt Machine Co., Henry, Louisville, Ky.
Warren Electric Appliance Co., Warren, Pa. (Electric)
Watts Regulator Co., Lawrence, Mass.
Whitehead Metal Products Co. of New York, Inc., New York, N. Y.
Whitlock Coil Pipe Co., Hartford, Conn.

HEATERS, WATER, STEEL, COAL FIRED

Bros Boiler & Mfg. Co., Wm., Minneapolis, Minn.
Fitzgibbons Boiler Co., New York, N. Y.
International Engineering Wks., Inc., Framingham, Mass.
Johnson Bros., Inc., Ferrysburg, Mich.
●Kewanee Boiler Corp., Kewanee, Ill.
Lookout Boiler & Mfg. Co., Chattanooga, Tenn.
National Radiator Co., The, Johnstown, Pa.
Pacific Steel Boiler Div., United States Radiator Corp., Detroit, Mich.
Spencer Heater Div., Aviation Mfg. Corp., Williamsport, Pa.

HEATING BOILERS

See Boilers, Heating

HEATING COILS

See Surface, Heating

HEATING SURFACE

See Surface, Heating

HOSE, METAL, FOR ELIMINATING COMPRESSOR VIBRATION

●American Metal Hose Branch, American Brass Co., Waterbury, Conn.
Atlantic Metal Hose Co., Inc., New York, N. Y.
Chicago Metal Hose Corp., Maywood, Ill.
Eclipse Aviation, Div. of Bendix Aviation Corp., Bendix, N. J.
Seamlex Co., Inc., Long Island City, N. Y.
Titeflex Metal Hose Co., Newark, N. J.
United Metal Hose Co., Inc., Long Island City, N. Y.

HOT WATER HEATING SYSTEMS

See Systems, Heating, Hot Water

HOT WATER PRESSURE REGULATORS

See Regulators, Pressure, Hot Water Heating Systems

HUMIDIFIERS, CENTRAL PLANT

●Air & Refrigeration Corp., New York, N. Y.
●Armstrong Machine Wks., Three Rivers, Mich.
●Barber-Colman Co., Rockford, Ill.
Brundage Co., Kalamazoo, Mich.
●Carrier Corp., Syracuse, N. Y.
●Johnson Service Co., Milwaukee, Wis.
Mellish & Murray Co., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Monmouth Products Co., Cleveland, O.
Parks-Cramer Co., Fitchburg, Mass.
●Powers Regulator Co., Chicago, Ill.
Research Corp., New York, N. Y.
Ross Engineering Corp., J. O., New York, N. Y.
Southworth Machine Co., Portland, Me.
Steamaire Co., Cincinnati, O.
Strandwitz & Co., Inc., W. J., Camden, N. J.
●Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Surface Combustion Corp., Toledo, O.
●Trane Co., La Crosse, Wis.
Viking Air Conditioning Corp., Cleveland, O.

HUMIDIFIERS, DIRECT, SPRAY HEAD

American Moistening Co., Providence, R. I.
Ames Co., W. R., San Francisco, Cal.
Anetsberger Bros., Chicago, Ill.
Bahnson Co., Winston-Salem, N. C.
Betz Air Conditioning Corp., Kansas City, Mo.
Binks Mfg. Co., Chicago, Ill.
Blower Application Co., Milwaukee, Wis.
●Buffalo Forge Co., Buffalo, N. Y.
Chelsea Fan & Blower Co., New York, N. Y.
International Moistening Co., Providence, R. I.
Lohman, Inc., Wm. J., New York, N. Y.
Manufacturers Machine Co., North Andover, Mass.
●Marley Co., Kansas City, Mo.
Mellish & Murray Co., Chicago, Ill.
Murray Mfg. Co., D. J., Wausau, Wis.
New York Blower Co., Chicago, Ill.
Parks-Cramer Co., Fitchburg, Mass.
Pfening Co., Fred D., Columbus, O.
Rhode Island Humidifier & Ventilating Co., Boston, Mass.
Ross Sprinkler Co., Pasadena, Cal.
Somers, Inc., H. J., Detroit, Mich.
Southworth Machine Co., Portland, Me.
Spray Engineering Co., Somerville, Mass.
Spraying Systems Co., Chicago, Ill.
Steamaire Co., Cincinnati, O.
Supreme Electric Products Corp., Rochester, N. Y.

HUMIDIFIERS FOR RADIATORS AND CONVECTORS

●Maid-O-Mist, Inc., Chicago, Ill.
Skilbeck Mfg. Co., Kenosha, Wis.

HUMIDIFIERS, RADIATOR VENT VALVE

●Maid-O-Mist, Inc., Chicago, Ill.
Skilbeck Mfg. Co., Kenosha, Wis.

HUMIDIFIERS, UNIT, ROOM TYPE (Without Heating)

Betz Air Conditioning Corp., Kansas City, Mo.
Coolmaster Corp., Chicago, Ill.
Corozone Air Conditioning Corp., Cleveland, O.
Cugley Incubator Co., Elkhart, Ind.
Hugo Mfg. Co., Duluth, Minn.
Kauffman Air Conditioning Corp., St. Louis, Mo.
Lion Mfg. Corp., Chicago, Ill.
Lohman, Inc., Wm. J., New York, N. Y.
Lowell Air Conditioning Corp., Philadelphia, Pa.
Norwood Filtration Co., The, Florence, Mass.
Sheer Co., H. M., Quincy, Ill.
Skilbeck Mfg. Co., Kenosha, Wis.
Somers, Inc., H. J., Detroit, Mich.
Southworth Machine Co., Portland, Me.
Standard Air Conditioning, Inc., New York, N. Y.
Standard Engineering Wks., Pawtucket, R. I.
Steamaire Co., Cincinnati, O.
●U. S. Air Conditioning Corp., Minneapolis, Minn.
Vigor-Aire Corp., Philadelphia, Pa.

HUMIDIFYING RADIATORS

See Radiators, Humidifying

HUMIDISTATS

American Moistening Co., Providence, R. I.
●Au-Temp-Co Corp., New York, N. Y.
●Automatic Products Co., Milwaukee, Wis.
Bahnson Co., Winston-Salem, N. C.
●Barber-Colman Co., Rockford, Ill.
Bristol Co., Waterbury, Conn.
●Detroit Lubricator Co., Detroit, Mich.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
G. M. Mfg. Co., New York, N. Y.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
H-B Instrument Co., Philadelphia, Pa.

● Advertisement in this issue. See Index to Advertisers, page 208.

●Johnson Service Co., Milwaukee, Wis.
Johnson Tool Co., Inc., East Providence, R. I.
Leeds & Northrup Co., Philadelphia, Pa.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Parks-Cramer Co., Fitchburg, Mass.
Penn Electric Switch Co., Goshen, Ind.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
●Powers Regulator Co., Chicago, Ill.
Spencer Thermostat Co., Attleboro, Mass.
Standard Engineering Wks., Pawtucket, R. I.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
White-Rodgers Electric Co., St. Louis, Mo.

HUMIDITY RECORDERS

See Recorders, Humidity

HUMIDITY AND TEMPERATURE CONTROLS

See Humidistats; Recorder-Controllers; Thermostats

HYDRAULIC SPEED CHANGERS

See Changers, Speed, Hydraulic Coupling

HYGROMETERS

American Moistening Co., Providence, R. I.
Bahnson Co., Winston-Salem, N. C.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Fee and Stemwedel, Inc., Chicago, Ill.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
G. M. Mfg. Co., New York, N. Y.
H-B Instrument Co., Philadelphia, Pa.
Hill, E. Vernon, Chicago, Ill.
International Moistening Co., Providence, R. I.
●Johnson Service Co., Milwaukee, Wis.
Johnson Tool Co., East Providence, R. I.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., Bridgeport, Conn.
Moeller Instrument Co., Richmond Hill, N. Y.
Palmer Co., Cincinnati (Norwood), O.
Parks-Cramer Co., Fitchburg, Mass.
Precision Thermometer & Instrument Co., Philadelphia, Pa.
Rochester Mfg. Co., Rochester, N. Y.
Scientific Instrument Co., Detroit, Mich.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice Co., H. O., Detroit, Mich.

HYGROSTATS

See Humidistats

IMMERSION THERMOSTATS

See Thermostats, Immersion

INDICATING THERMOMETERS

See Thermometers, Indicating

INDICATOR-CONTROLLERS, PRESSURE

Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
●Cash Co., A. W., Decatur, Ill.
Foxboro Co., Foxboro, Mass.
Mason-Neilan Regulator Co., Boston, Mass.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

INDICATOR-CONTROLLERS, RELATIVE HUMIDITY

Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Foxboro Co., Foxboro, Mass.
●Johnson Service Co., Milwaukee, Wis.
Leeds & Northrup Co., Philadelphia, Pa.
Mason-Neilan Regulator Co., Boston, Mass.
●Powers Regulator Co., Chicago, Ill.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

INDICATOR-CONTROLLERS, TEMPERATURE

Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
●Cash Co., A. W., Decatur, Ill.
Foxboro Co., Foxboro, Mass.
●Johnson Service Co., Milwaukee, Wis.
Leeds & Northrup Co., Philadelphia, Pa.
Mason-Neilan Regulator Co., Boston, Mass.
●Powers Regulator Co., Chicago, Ill.
Pyrometer Instrument Co., New York, N. Y.
Tagliabue Mfg Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Thwing-Albert Instrument Co., Philadelphia, Pa.
Wheelco Instruments Co., Chicago, Ill.

INDICATORS, CARBON DIOXIDE, BOILER ROOM

For portable CO_2 analyzers, see Analyzers, Carbon Dioxide, Portable

Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Defender Automatic Regulator Co., St. Louis, Mo.
Engelhard, Inc., Chas., Newark, N. J.
Hays Corp., Michigan City, Ind.
Leeds & Northrup Co., Philadelphia, Pa.
Weaver Mfg. Co., Springfield, Ill.

INDICATORS, SOUND LEVEL

General Electric Co., Schenectady, N. Y.
Industrial Apparatus Co., Chicago, Ill.

INDIRECT HEATING SURFACE

See Surface, Heating

INDIRECT WATER HEATERS

See Heaters, Water, Indirect

INDUSTRIAL AIR CONDITIONERS

See Units, Air Conditioning, Industrial Type

INSTANTANEOUS WATER HEATERS

See Heaters, Water, Steam, Instantaneous

INSULATION, BOILER AND TANK

Acme Asbestos Covering & Flooring Co., Chicago, Ill.
Alfol Insulation Co., Inc., New York, N. Y. (Aluminum foil)
Aluminum Aircell Insulation Co., Detroit, Mich.
●Armstrong Cork Co., Lancaster, Pa.
Baldwin-Hill Co., Trenton, N. J. (Rock wool)
Barrett Co., The, New York, N. Y.
●Carey Co., Philip, Lockland, Cincinnati, O.
●Cork Import Corp., New York, N. Y. (Cork)
Cork Insulation Co., Inc., New York, N. Y. (Cork)
Eagle-Picher Lead Co., Cincinnati, O.
Ehret Magnesia Mfg. Co., Valley Forge, Pa. (Magnesia)
General Insulating & Mfg. Co., St. Louis, Mo.
International Vermiculite Co., Springfield, Ill.
Jamar Co., Walker, Duluth, Minn.
Johns-Manville, New York, N. Y.
Keasbey Co., Robert A., New York, N. Y. (Asbestos)
Keasbey & Mattison Co., Ambler, Pa.
Minfelt Insulation Co., The, Toledo, O.
●Mundet Cork Corp., Brooklyn, N. Y. (Cork)
Norristown Magnesia & Asbestos Co., Norristown, Pa. (Asbestos and magnesia)
●Owens-Corning Fiberglas Corp., Toledo, O. (Blanket)
Pacific States Felt & Mfg. Co., Inc., San Francisco, Cal.
Refractory & Insulation Corp., New York, N. Y. (Blanket, block, cement)
Ruberoid Co., New York, N. Y. (Asbestos, magnesia)
Sall Mountain Co., Chicago, Ill.
Schundler & Co., Inc., F. E., Long Island City, N. Y.
Smith & Kanzler, Inc., Elizabeth, N. J.
Standard Asbestos Mfg. Co., Chicago, Ill.
Standard Lime and Stone Co., Baltimore, Md. (Rock wool)
Therminsul Corp., Kalamazoo, Mich. (Felted block)
Union Asbestos & Rubber Co., Cicero, Ill.
United Cork Co., Kearney, N. J. (Cork)
●Wilson, Inc., Grant, Chicago, Ill.
Zonolite Co., The, Detroit, Mich. (Plastic)

INSULATION, BUILDING

Acme Asbestos Covering & Flooring Co., Chicago, Ill. (Rock wool)
Air-O-Cel Industries, Inc., Detroit, Mich.
Alfol Insulation Co., New York, N. Y. (Aluminum foil)
Alton Mineral Wool Insulation Co., Alton, Ill.
American Flange & Mfg. Co., Inc., New York, N. Y. (Metal sheets)
American Hair & Felt Co., Chicago, Ill. (Hair felt)
●Armstrong Cork Co., Lancaster, Pa. (Corkboard, fibreboard)
Bache & Co., Semon, New York, N. Y. (Glass wool)
Baldwin-Hill Co., Trenton, N. J. (Rock wool)
Barber Asphalt Corp., Barber, N. J.
Barrett Co., The, New York, N. Y.
Berry, Jr. & Co., Inc., F. E., Boston, Mass.
Butterworth, Jr., B. T., New Canaan, Conn. (Cork)
Cabot, Inc., Samuel, Boston, Mass.(Flexible)
●Carey Co., Philip, Lockland, Cincinnati, O. (Rock wool)
Celotex Corp., The, Chicago, Ill.
Chamberlin Metal Weather Strip Co., Detroit, Mich. (Rock wool)
Certain-teed Products Corp., New York, N. Y. (Board, reflective)
●Cork Import Corp., New York, N. Y. (Cork)
Cork Insulation Co., Inc., New York, N. Y. (Corkboard)
Cornell Wood Products Co., Chicago, Ill.
Crown Cork & Seal Co., Baltimore, Md.
Doheny Co., John J., Belmont, Mass. (Blanket)
Eagle-Picher Lead Co., Cincinnati, O. (Mineral wool)
Fir-Tex Insulating Board Co., St. Helens, Ore. (Wood fibreboard)
Flintkote Co., New York, N. Y. (Fiber board and rock wool)
General Insulating & Mfg. Co., St. Louis, Mo. (Loose fill-Blanket-Bat)
General Insulating Products Co., Brooklyn, N. Y. (Rock wool)
Hinde & Dauch Paper Co., Sandusky, O.
Insulite Co., Minneapolis, Minn. (Wood fibre)
Insul-Wool Insulation Corp., Wichita, Kan.
International Vermiculite Co., Springfield, Ill. (Loose fill)

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Johns-Manville, New York, N. Y. (Rock wool and wood fibreboard)
Johnston Tin Foil & Metal Co., St. Louis, Mo. (Foil, aluminum, tin, lead)
Keasbey Co., Robert A., New York, N. Y. (Rock wool)
Keasbey & Mattison Co., Ambler, Pa. (Asbestos)
Kimberly-Clark Corp., Neenah, Wis.
Marblehead Lime Co., Chicago, Ill. (Rock wool)
Masonite Corp., Chicago, Ill. (Fibre board)
Masonite Corp., Cellufoam Products Div., Chicago, Ill.
Mineral Insulation Co., Chicago Ridge, Ill. (Rock wool)
Minfelt Insulation Co., The, Toledo, O.
Mitchell & Smith, Inc., Detroit, Mich. (Cork)
●Mundet Cork Corp., Brooklyn, N. Y. (Cork)
National Gypsum Co., Buffalo, N. Y.
●Pacific Lumber Co., The, San Francisco, Cal.
Pacific States Felt & Mfg. Co., Inc., San Francisco, Cal.
Plastergon Wall Board Co., Buffalo, N. Y. (Rigid board)
Refractory & Insulation Corp., New York, N. Y. (Rock, slag wool)
Rock Products Co., Nashville, Tenn. (Rock wool)
Rock Wool Products Co., Wabash, Ind. (Loose fill)
Ruberoid Co., New York, N. Y. (Mineral wool and aluminum foil)
Russell Co., F. C., Cleveland, O.
Specialty Converters, Inc., East Braintree, Mass. (Reflective insulation)
Sprayo-Flake Co., Chicago, Ill.
Standard Asbestos Mfg. Co., Chicago, Ill. (Asbestos, hairfelt)
Standard Lime & Stone Co., Baltimore, Md. (Rock wool)
Therminsul Corp., Kalamazoo, Mich. (Rock wool block)
Truscon Steel Co., Youngstown, O. (Insulation board sealed between metal sheets)
United Cork Companies, Lyndhurst, N. J. (Cork)
United States Gypsum Co., Chicago, Ill. (Wool and board)
United States Mineral Wool Co., Chicago, Ill. (Mineral wool)
Universal Gypsum & Lime Co., Chicago, Ill. (Loose fill)
Upson Co., Lockport, N. Y.
Wilson & Co., Chicago, Ill. (Board)
●Wilson, Inc., Grant, Chicago, Ill. (Rock wool)
Wood Conversion Co., St. Paul, Minn. (Nu-Wood board, balsam-wool blanket)
Zonolite Co., The, Detroit, Mich. (Loose fill)

INSULATION, CEILING AND WALL, SOUND DEADENING

Acoustical treatment only—for thermal insulation, see Insulation, Building

Air-O-Cel Industries, Inc., Detroit, Mich.
●Armstrong Cork Co., Lancaster, Pa.
Barrett Co., The, New York, N. Y.
Burgess Battery Co., Chicago, Ill.
Celotex Corp., The, Chicago, Ill.
Doheny Co., John J., Belmont, Mass.
●Felters Co., Inc., Boston, Mass.
General Insulating & Mfg. Co., St. Louis, Mo.
Insulite Co., Minneapolis, Minn.
Insul-Wool Insulation Corp., Wichita, Kan.
Johns-Manville, New York, N. Y.
Keasbey & Mattison Co., Ambler, Pa.
Masonite Corp., Chicago, Ill. (Fibreboard)
Masonite Corp., Cellufoam Products Div., Chicago, Ill.
Mitchell & Smith, Inc., Detroit, Mich.
●Mundet Cork Corp., Brooklyn, N. Y.
Pacific States Felt & Mfg. Co., Inc., San Francisco, Cal.
Sprayo-Flake Co., Chicago, Ill.
Therminsul Corp., Kalamazoo, Mich.
Upson Co., Lockport, N. Y.
Wood Conversion Co., St. Paul, Minn. (Nu-Wood, Balsam-wool)

INSULATION, DUCT, SOUND DEADENING

For application inside duct

Air Conditioning Utilities Co., New York, N. Y.
American Hair & Felt Co., Chicago, Ill.
Atlas Asbestos Co., Ltd., Montreal, Que., Canada
Barrett Co., The, New York, N. Y.
Burgess Battery Co., Chicago, Ill.
Cabot, Inc., Samuel, Boston, Mass.
●Carey Co., Philip, Cincinnati, O.
Celotex Corp., The, Chicago, Ill.
●Felters Co., Inc., Boston, Mass.
Johns-Manville, New York, N. Y.
Masonite Corp., Chicago, Ill.
Masonite Corp., Cellufoam Products Div., Chicago, Ill.
Maxim Silencer Co., Hartford, Conn.
Mortell Co., J. W., Chicago, Ill.
Nelson Mfg. Co., B. F. Minneapolis, Minn.
●Owens-Corning Fiberglas Corp., Toledo, O.
Pacific States Felt & Mfg. Co., Inc., San Francisco, Cal.
Plant Rubber & Asbestos Works, San Francisco, Cal.
Western Felt Works, Chicago, Ill.
Western Silicair Products, Inc., Burbank, Cal.
●Wilson, Inc., Grant, Chicago, Ill.

INSULATION, DUCT, THERMAL

Acme Asbestos Covering & Flooring Co., Chicago, Ill. (Asbestos)
Air Conditioning Utilities Co., New York, N. Y.
Air-O-Cel Industries, Inc., Detroit, Mich.
Alfol Insulation Co., New York, N. Y. (Aluminum foil)
American Flange & Mfg. Co., Inc., New York, N. Y. (Metal sheets)
American Hair & Felt Co., Chicago, Ill. (Hair felt)
●Armstrong Cork Co., Lancaster, Pa. (Corkboard, fibreboard)
Atlas Asbestos Co., Ltd., Montreal, Que., Canada
Barrett Co., The, New York, N. Y.
Berry, Jr. & Co., Inc., F. E., Boston, Mass.
Cabot, Inc., Samuel, Boston, Mass. (Flexible)
●Carey Co., Philip, Lockland, Cincinnati, O. (Asbestos)
Celotex Corp., The, Chicago, Ill.
●Cork Import Corp., New York, N. Y. (Cork)
Cork Insulation Co., Inc., New York, N. Y. (Cork board)
Crown Cork & Seal Co., Baltimore, Md.
Eagle-Picher Lead Co., Cincinnati, O. (Mineral wool blankets)
Ehret Magnesia Mfg. Co., Valley Forge, Pa. (Cork, magnesia, hair felt)
●Felters Co., Inc., Boston, Mass. (Wool felt)
Fir-Tex Insulating Board Co., St. Helens, Ore. (Wood fibreboard)
General Insulating & Mfg. Co., St. Louis, Mo. (Block)
General Insulating Products Co., Brooklyn, N. Y. (Acoustic rock wool)
Insulite Co., Minneapolis, Minn. (Wood fibre)
International Vermiculite Co., Springfield, Ill. (Block)
Johns-Manville, New York, N. Y. (Rock cork, asbestos)
Keasbey Co., Robert A., New York, N. Y. (Asbestos and cork)
Keasbey & Mattison Co., Ambler, Pa. (Asbestos)
Masonite Corp., Chicago, Ill. (Fibreboard)
Masonite Corp., Cellufoam Products Div., Chicago, Ill.
Mineral Insulation Co., Chicago Ridge, Ill. (Rock wool)
Minfelt Insulation Co., The, Toledo, O.
Mitchell & Smith, Inc., Detroit, Mich. (Cork)
●Mundet Cork Corp., Brooklyn, N. Y. (Cork)
Nelson Mfg. Co., B. F., Minneapolis, Minn.
Norristown Magnesia & Asbestos Co., Norristown, Pa. (Asbestos and wool felt)
●Owens-Corning Fiberglas Corp., Toledo, O. (Blanket)
Pacific States Felt & Mfg. Co., Inc., San Francisco, Cal.
Plant Rubber & Asbestos Works, San Francisco, Cal.
Presstite Engineering Co., St. Louis, Mo. (Adhesive)
Refractory & Insulation Corp., New York, N. Y. (Block, blanket)
Rock Wool Products Co., Wabash, Ind.
Ruberoid Co., New York, N. Y. (Asbestos cellular and laminated sheets or blocks)
Russell Co., F. C., Cleveland, O.
Sall Mountain Co., Chicago, Ill. (Asbestos)
Schundler & Co., Inc., F. E., Long Island City, N. Y.
Smith & Kanzler, Inc., Elizabeth, N. J. (Asbestos air cell type)
Sprayo-Flake Co., Chicago, Ill.
Standard Asbestos Mfg. Co., Chicago, Ill. (Asbestos, hair felt)
Therminsul Corp., Kalamazoo, Mich. (Rock wool bats, loose and granulated)
United Cork Companies, Lyndhurst, N. J. (Cork)
Western Felt Wks., Chicago, Ill. (Felt)
Western Silicair Products, Inc., Burbank, Cal.
Wilson & Co., Chicago, Ill. (Flexible)
●Wilson, Inc., Grant, Chicago, Ill.
Wood Conversion Co., St. Paul, Minn. (Balsam-wool)
Zonolite Co., The, Detroit, Mich. (Plastic)

INSULATION, PIPE

Acme Asbestos Covering & Flooring Co., Chicago, Ill.
Air Conditioning Utilities Co., New York, N. Y.
Alfol Insulation Co., New York, N. Y. (Aluminum foil)
●American District Steam Co., North Tonawanda, N. Y. (Underground)
American Hair & Felt Co., Chicago, Ill.
●Armstrong Cork Co., Lancaster, Pa. (Cork)
Baldwin-Hill Co., Trenton, N. J. (Rock wool)
Atlas Asbestos Co., Ltd., Montreal, Que., Canada
●Carey Co., Philip, Lockland, Cincinnati, O. (Asbestos, magnesia)
●Cork Import Corp., New York, N. Y. (Cork)
Cork Insulation Co., New York, N. Y.
Eagle-Picher Lead Co., Cincinnati, O. (Mineral wool)
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
General Insulating & Mfg. Co., St. Louis, Mo. (Moulded)
International Vermiculite Co., Springfield, Ill. (Vermiculite)
Jamar Co., Walker, Duluth, Minn.
Johns-Manville, New York, N. Y. (Asbestos, magnesia, rock cork)
Keasbey Co., Robert A., New York, N. Y. (Asbestos and cork)
Keasbey & Mattison Co., Ambler, Pa. (Asbestos, magnesia)
Miller Rubber Co., Inc., Akron, O. (Sponge rubber)
Minfelt Insulation Co., The, Toledo, O.
Mitchell & Smith, Inc., Detroit, Mich. (Cork)
●Mundet Cork Corp., Brooklyn, N. Y. (Cork)
Norristown Magnesia & Asbestos Co., Norristown, Pa. (Asbestos, magnesia)
●Owens-Corning Fiberglas Corp., Toledo, O. (Sectional and flexible)
Pacific States Felt & Mfg. Co., Inc., San Francisco, Cal.
Plant Rubber & Asbestos Works, San Francisco, Cal.
●Porter & Co., Inc., H. W., Newark, N. J. (Underground)
●Ric-wiL Co., Cleveland, O. (Underground)

● Advertisement in this issue. See Index to Advertisers, page 208.

Ruberoid Co., New York, N. Y. (Asbestos, magnesia)
Sall Mountain Co., Chicago, Ill. (Asbestos)
Schundler & Co., Inc., F. E., Long Island City, N. Y.
Smith & Kanzler, Inc., Elizabeth, N. J. (Asbestos air cell, wool felt and hair felt)
Standard Asbestos Mfg. Co., Chicago, Ill.
Standard Lime & Stone Co., Baltimore, Md. (Rockwool)
Union Asbestos & Rubber Co., Cicero, Ill.
United Cork Companies, Lyndhurst, N. J.
●Wilson, Inc., Grant, Chicago, Ill.
Wyckoff & Son Co., A., Elmira, N. Y. (Wood)

IONIZATION APPARATUS

American Hydrozone Co., Inc., New York, N. Y.
Corozone Air Conditioning Corp., Cleveland, O.
Electroaire Corp., Chicago, Ill.
Lowell Air Conditioning Corp., Philadelphia, Pa.
Montgomery Bros., San Francisco, Cal.
Norwood Filtration Co., The, Florence, Mass.
Ozo-Ray Process Corp., Chicago, Ill.
United States Ozone Co. of America, Scottdale, Pa.

IRON BODY VALVES

See Valves, Gate; and Valves, Globe

JACKETED PIPE

See Pipe and Fittings, Jacketed

JOINTS, PIPE, ELECTRICAL INSULATING

Barco Mfg. Co., Chicago, Ill.

JOINTS, PIPE, EXPANSION, PACKLESS

●American District Steam Co., North Tonawanda, N. Y.
Badger Fire Extinguisher Co., Boston, Mass.
●Badger & Sons Co., E. B., Boston, Mass. (Corrugated copper, stainless steel)
Barco Mfg. Co., Chicago, Ill.
Belfield Co., H., Philadelphia, Pa.
Central Station Steam Co., Detroit, Mich.
Croll-Reynolds Engineering Co., Inc., New York, N. Y.
Dahlquist Mfg. Co., Inc., Boston, Mass.
Foster Wheeler Corp., New York, N. Y.
●Fulton Sylphon Co., Knoxville, Tenn.
Griscom-Russell Co., The, New York, N. Y.
Harris & Co., Arthur, Chicago, Ill.
Kopperman & Sons, Joseph, Philadelphia, Pa.
Northern Indiana Brass Co., Elkhart, Ind.
Semet-Solvay Engineering Corp., New York, N. Y.
Taylor Forge & Pipe Wks., Chicago, Ill.
United States Rubber Co., New York, N. Y.
Walworth Co., New York, N. Y.

JOINTS, PIPE, EXPANSION, SLIP

●American District Steam Co., North Tonawanda, N. Y.
Central Station Steam Co., Detroit, Mich.
Dresser Mfg. Co., Bradford, Pa.
Duriron Co., Inc., Dayton, O. (Acid resisting)
●Fulton Sylphon Co., Knoxville, Tenn.
Hasco Valve & Machine Co., Milwaukee, Wis.
Howard Iron Works & Alberger Heater Co., Buffalo, N. Y.
●Illinois Engineering Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Northern Indiana Brass Co., Elkhart, Ind.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Straight Line Foundry & Machine Corp., Direct Separator Div., The, Syracuse, N. Y.
Taylor Forge & Pipe Wks., Chicago, Ill.
Walworth Co., New York, N. Y.
●Webster & Co., Warren, Camden, N. J.
●Yarnall-Waring Co., Philadelphia, Pa.

KATA THERMOMETERS

See Thermometers, Kata

LACQUERS

See Enamels and Lacquers

LAMPS, STERILIZING, FOR DUCT INSTALLATION

General Electric Co., Lamp Dept., Nela Park, Cleveland, O.
●Westinghouse Electric & Mfg. Co., Bloomfield, N. J.

LEAD PIPE

See Pipe, Lead

LEAD SHEETS

See Sheets, Lead

LEAK DETECTORS

See Detectors, Leak, Refrigerant

LEATHER BELTING

See Belting, Flat, Leather

LEATHER PACKING

See Packing, Leather

LIQUID LEVEL GAGES

See Gages, Liquid Level

LIQUID LEVEL RECORDERS

See Recorders, Liquid Level

LIQUID PRESSURE REGULATORS

See Regulators, Pressure, Liquid

LOCK FORMING MACHINES

See Machines, Pittsburgh Lock Forming

LOUVERS AND SHUTTERS, AUTOMATICALLY OR MANUALLY CONTROLLED

●Air Controls, Inc., Cleveland, O.
Airmaster Corp., Chicago, Ill.
Allen Corp., Detroit, Mich.
American Blower Corp., Detroit, Mich.
American Coolair Corp., Jacksonville, Fla.
American Foundry & Furnace Co., Bloomington, Ill.
American Warming & Ventilating Co., Toledo, O.
Ames Co., W. R., San Francisco, Cal.
Arex Co., Chicago, Ill.
●Autovent Fan & Blower Co., Chicago, Ill.
●Barber-Colman Co., Rockford, Ill.
Belanger Fan & Blower Co., Detroit, Mich.
Belco Exhaust Fan Mfg. Co., St. Louis, Mo.
●Bishop & Babcock Mfg. Co., Cleveland, O.
●Buffalo Forge Co., Buffalo, N. Y.
Burt Mfg. Co., Akron, O.
California Cornice, Steel & Supply Corp., Los Angeles, Cal.
Campbell Heating Co., E. K., Kansas City, Mo.
Champion Blower & Forge Co., Lancaster, Pa.
Chelsea Fan & Blower Co., New York, N. Y.
Chicago Metal Mfg. Co., Chicago, Ill.
Circulators & Devices Mfg. Corp., New York, N. Y.
Clay Equipment Corp., Cedar Falls, Ia.
Economy Electric Mfg. Co., Chicago, Ill.
Electrovent Fan & Mfg. Co., Chicago, Ill.
Elgo Shutter & Mfg. Co., Detroit, Mich.
Falstrom Co., Passaic, N. J.
General Blower Co., Inc., Philadelphia, Pa.
General Regulator Corp., Chicago, Ill.
Gillian Mfg. Co., Ferndale, Mich.
Hirschman Co., W. F., Buffalo, N. Y.
International Engineering Inc., Dayton, O.
Johnson Fan & Blower Corp., Chicago, Ill.
Jordan & Co., Paul R., Indianapolis, Ind.
Kelvin-White Co., Boston, Mass.
King Ventilating Co., Owatonna, Minn.
Kirk & Blum Mfg. Co., Cincinnati, O.
Kisco Co., Inc., St. Louis, Mo.
Lohman, Inc., Wm. J., New York, N. Y.
Martin Metal Mfg. Co., Wichita, Kan.
Meier Electric & Machine Co., Indianapolis, Ind.
Meyer Mfg. Co., Detroit, Mich.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Mountain States Equipment Co., Denver Colo.
Myers Electric Co., Pittsburgh, Pa.
Peerless Electric Co., Warren, O.
Robertson Co., H. H., Pittsburgh, Pa.
Schoedinger, F. O., Columbus, O.
Signal Electric Mfg. Co., Menominee, Mich.
Supreme Heater & Ventilating Corp., St. Louis, Mo. (Oscillating)
●Tuttle & Bailey, Inc., New Britain, Conn.
United States Register Co., Battle Creek, Mich.
Utility Fan Corp., Los Angeles, Cal.
Van Noorden Co., E., Boston, Mass.
●Waterloo Register Co., Waterloo, Ia.
Willis Mfg. Co., Inc., Galesburg, Ill.

LOW WATER CUT-OFFS

See Cut-Offs, Low Water, Heating Boiler

MACHINES, CLEANING, AIR FILTER

Air Filter Engineering Co., Omaha, Neb.

MACHINES AND FILM, X-RAY

Eastman Kodak Co., Rochester, N. Y.
Kelly-Koet, Covington, Ky.
Westinghouse X-Ray Co., Inc., Long Island City, N. Y.

MACHINES, PIPE CUTTING AND THREADING, PORTABLE

Air Reduction Sales Co., New York, N. Y. (Cutting and beveling)
Beaver Pipe Tools, Inc., Warren, O.
Curtis & Curtis Co., Bridgeport, Conn.
Landis Machine Co., Inc., Waynesboro, Pa.
Linde Air Products Co., The, New York, N. Y. (Cutting and beveling)
National Machine Works, Chicago, Ill.
Nye Tool & Machine Wks., The, Chicago, Ill.
Oster Mfg. Co., Cleveland, O.
Peerless Mach. Co., Racine, Wis.
Ridge Tool Co., Elyria, O. (Hand)
Toledo Pipe Threading Machine Co., Toledo, O.

MACHINES, PIPE CUTTING AND THREADING, STATIONARY

Beaver Pipe Tools, Inc., Warren, O.
Bignall & Keeler Machine Wks., Edwardsville, Ill.
●Bullard Co., The, Bridgeport, Conn. (Vertical, threading & boring)
Curtis & Curtis Co., Bridgeport, Conn.
Jarecki Mfg. Co., Erie, Pa.
Landis Machine Co., Inc., Waynesboro, Pa.

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Merrell Mfg. Co., Toledo, O.
Oster Mfg. Co., Cleveland, O.
Saunders Sons, Inc., D., Yonkers, N. Y.
Toledo Pipe Threading Machine Co., Toledo, O.

MACHINES, PITTSBURGH LOCK FORMING

Binkley Mfg. Co., Warrenton, Mo.
Lockformer Co., Chicago, Ill.
Maplewood Machinery Co., Inc., Chicago, Ill.
Rafter Machine Co., Belleville, N. J.
Ward Machinery Co., Chicago, Ill.
●Whitney Metal Tool Co., Rockford, Ill.

MACHINES, REFRIGERATION, ABSORPTION

Philadelphia & Reading Coal & Iron Co., Philadelphia, Pa.
Rafter Machine Co., Belleville, N. J.
Vogt Machine Co., Henry, Louisville, Ky.
Williams Oil-O-Matic Heating Corp., Bloomington, Ill.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
●York Ice Machinery Corp., York, Pa.

MALLEABLE UNIONS

See Unions, Malleable

MANIFOLDS, REFRIGERATION

●Baker Ice Machine Co., Inc., Omaha, Neb.
Imperial Brass Mfg. Co., Chicago, Ill.
Kerotest Mfg. Co., Pittsburgh, Pa.
Superior Valve and Fittings Co., Pittsburgh, Pa.
●York Ice Machinery Corp., York, Pa.

MANOMETERS

Bacharach Industrial Instrument Co., Pittsburgh, Pa.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Builders Iron Foundry, Providence, R. I.
Defender Automatic Regulator Co., St. Louis, Mo.
Detroit Air Meter Co., Detroit, Mich.
Friez & Sons, Julien P., Baltimore, Md.
Hill, E. Vernon, Chicago, Ill.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
●Meriam Co., The, Cleveland, O.
Morey & Jones, Ltd., Los Angeles, Cal.
Precision Thermometer & Instrument Co., Philadelphia, Pa.
Republic Flow Meters Co., Chicago, Ill.
Scientific Instrument Co., Detroit, Mich.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice Co., H. O., Detroit, Mich.

MECHANICAL DRIVE TURBINES

See Turbines, Mechanical Drive

MECHANICAL SPEED CHANGERS

See Changers, Speed, Mechanical

MECHANICAL TRAPS

See Traps, Steam, Mechanical

MERCURY SWITCHES

See Switches, Mercury

METAL HOSE

See Hose, Metal, for Eliminating Compressor Vibration

METALLIC PACKING

See Packing, Metallic

METERS, AIR VELOCITY, DIRECT READING

Detroit Air Meter Co., Detroit, Mich.
Friez & Sons, Julien P., Baltimore, Md.
●Illinois Testing Laboratories, Inc., Chicago, Ill.
Taylor Instrument Companies, Rochester, N. Y.

METERS, CONDENSATION

●American District Steam Co., North Tonawanda, N. Y.
Buffalo Meter Co., Buffalo, N. Y.
Central Station Steam Co., Detroit, Mich.
Morehead Mfg. Co., Detroit, Mich.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Worthington-Gamon Meter Co., Harrison, N. J.

METERS, FLOW, REFRIGERANT

Builders Iron Foundry, Providence, R. I.

METERS, FLOW, STEAM

●American District Steam Co., North Tonawanda, N. Y.
American Meter Co., New York, N. Y.
Bailey Meter Co., Cleveland, O.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Builders Iron Foundry, Providence, R. I.
●Cochrane Corp, Philadelphia, Pa.
Foxboro Co., Foxboro, Mass.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
Leeds & Northrup Co., Philadelphia, Pa.
Mason-Neilan Regulator Co., Boston, Mass.
●Meriam Co., The, Cleveland, O.
Morey & Jones, Ltd., Los Angeles, Cal.
Republic Flow Meters Co., Chicago, Ill.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

METERS, PROCESS LIQUID

Bailey Meter Co., Cleveland, O.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Buffalo Meter Co., Buffalo, N. Y.
Builders Iron Foundry, Providence, R. I.
Foxboro Co., Foxboro, Mass.
Mason-Neilan Regulator Co., Boston, Mass.
●Meriam Co., The, Cleveland, O.
Morey & Jones, Ltd., Los Angeles, Cal.
Republic Flow Meters Co., Chicago, Ill.
Schutte & Koerting Co., Philadelphia, Pa.
Taylor Instrument Companies, Rochester, N. Y.

METERS, WATER

Bailey Meter Co., Cleveland, O.
Buffalo Meter Co., Buffalo, N. Y.
Builders Iron Foundry, Providence, R. I.
Foxboro Co., Foxboro, Mass.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
National Meter Co., Brooklyn, N. Y.
Neptune Meter Co., New York, N. Y.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
Republic Flow Meters Co., Chicago, Ill.
Union Water Meter Co., Worcester, Mass.
Worthington-Gamon Meter Co., Harrison, N. J.

MIXING VALVES

See Valves, Mixing, Steam and Water

MODULATING VALVES

See Valves, Radiator, Steam and Hot Water

MOTOR BASES

See Bases and Pads, Vibration Isolating; Bases, Motor, Tension Adjusting

MOTOR CONTROLLERS

See Controllers and Starters, Motor

MOTOR OPERATED VALVES

See Valves, Motor Operated

MOTOR STARTERS

See Controllers and Starters, Motor

MOTORS, ELECTRIC, FRACTIONAL HP

Baldor Electric Co., St. Louis, Mo.
●Barber-Colman Co., Rockford, Ill.
Black & Decker Mfg. Co., Towson, Md.
Bodine Electric Co., Chicago, Ill.
Brown-Brockmeyer Co., Dayton, O.
Canatsey Electric Mfg. Co., Kansas City, Mo.
●Century Electric Co., St. Louis, Mo.
Delco Appliance Co., Rochester, N. Y.
Delco Products Corp., Dayton, O.
Diehl Mfg. Co., Elizabethport, N. J.
Emerson Electric Mfg. Co., St. Louis, Mo.
General Electric Co., Schenectady, N. Y.
Holtzer-Cabot Electric Co., Boston, Mass.
●Howell Electric Motors Co., Howell, Mich.
Janette Mfg. Co., Chicago, Ill.
Leland Electric Co., Dayton, O.
Marathon Electric Mfg. Corp., Wausau, Wis.
Master Electric Co., Dayton, O.
Ohio Electric Mfg. Co., Cleveland, O.
Peerless Electric Co., Warren, O.
Reynolds Electric Co., Chicago, Ill.
Robbins & Myers, Inc., Springfield, O.
Speedway Mfg. Co., Chicago (Cicero), Ill.
Sterling Electric Motors, Inc., Los Angeles, Cal.
U. S. Electrical Motors, Inc., Los Angeles, Cal.
Victor Electric Products, Inc., Cincinnati, O.
●Wagner Electric Corp., St. Louis, Mo.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOTORS, ELECTRIC, 1 HP AND OVER

Allis Co., Louis, The, Milwaukee, Wis.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Baldor Electric Co., St. Louis, Mo.
Brown-Brockmeyer Co., Dayton, O.
Burke Electric Co., Erie, Pa.
Canatsey Electric Mfg. Co., Kansas City, Mo.
●Century Electric Co., St. Louis, Mo.
Continental Electric Co., Inc., Newark, N. J.
Crocker-Wheeler Elec. Mfg. Co., Ampere, N. J.
Delco Products Corp., Dayton, O.
Diehl Mfg. Co., Elizabethport, N. J.
Electric Machinery Mfg. Co., Minneapolis, Minn.
Emerson Electric Mfg. Co., St. Louis, Mo.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Holtzer-Cabot Electric Co., Boston, Mass. (2 & less)

●Howell Electric Motors Co., Howell, Mich.
Ideal Electric & Mfg. Co., Mansfield, O.
Imperial Electric Co., Akron, O.
Janette Mfg. Co., Chicago, Ill.
Leland Electric Co., Dayton, O.
Lincoln Electric Co., Cleveland, O.
Marathon Electric Mfg. Corp., Wausau, Wis.
Marble-Card Electric Co., Gladstone, Mich.
Master Electric Co., Dayton, O.
Peerless Electric Co., Warren, O.
Philadelphia Gear Co., Philadelphia, Pa. (Geared)
Reliance Electric & Engineering Co., Cleveland, O.
Robbins & Myers, Inc., Springfield, O.
Star Electric Motor Co., Bloomfield, N. J.
Sterling Electric Motors, Inc., Los Angeles, Cal.
U. S. Electrical Motors, Inc., Los Angeles, Cal.
●Wagner Electric Corp., St. Louis, Mo.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Zobell Electric Motor Corp., Garwood, N .J.

MUSHROOM VENTILATORS

See Ventilators, Mushroom

NEEDLE VALVES

See Valves, Needle

NIPPLES, PIPE, BRASS AND COPPER

Acheson Mfg. Co., Rankin, Pa.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Chicago Nipple Mfg. Co., Chicago, Ill.
Crane Co., Chicago, Ill.
●Devlin Mfg. Co., Inc., Thos., Burlington, N. J.
Flagg & Co., Inc., Stanley G., Philadelphia, Pa.
Grabler Mfg. Co., Cleveland, O.
●Grinnell Co., Inc., Providence, R. I.
Imperial Brass Mfg. Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Jenkins Mfg. Co., New York, N. Y.
Limbert & Co., Geo. B., Chicago, Ill.
●Mueller Brass Co., Port Huron, Mich.
Parker Appliance Co., Cleveland, O.
Penn Mfg. Corp. of Washington, Pa., Washington, Pa.
Phoenix Brass Fittings Corp., Irvington, N. J.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Rockford Brass Works, Rockford, Ill.
Shaw-Kendall Engineering Co., Toledo, O.
●Streamline Pipe & Fittings Div., Mueller Brass Co., Port Huron, Mich.
Walworth Co., New York, N. Y.
Ward Foundries, Inc., J. P., Blossburgh, Pa.
Weatherhead Co., Cleveland, O.

NIPPLES, PIPE, IRON AND STEEL

Alloy Steel Products Co., Linden, N. J. (Stainless steel)
●Byers Co., A. M., Pittsburgh, Pa. (Wrought iron)
Chicago Nipple Mfg. Co., Chicago, Ill.
Colonial Alloys Co., Specialties Div., Philadelphia, Pa.
Crane Co., Chicago, Ill.
Detroit Brass & Malleable Wks., Detroit, Mich.
●Devlin Mfg. Co., Inc., Thos., Burlington, N. J.
Dresser Mfg. Co., Bradford, Pa.
Flagg & Co., Inc., Stanley G., Philadelphia, Pa.
Grabler Mfg. Co., Cleveland, O.
●Grinnell Co., Inc., Providence, R. I.
Hasco Valve & Machine Co., Milwaukee, Wis.
Illinois Malleable Iron Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Limbert & Co., Geo. B., Chicago, Ill.
Penn Mfg. Corp. of Washington, Pa., Washington, Pa.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Shaw-Kendall Engineering Co., Toledo, O.
Walworth Co., New York, N. Y.
Ward Foundries, Inc., J. P., Blossburgh, Pa.

NOISE ELIMINATORS

See Bases and Pads, Vibration Isolating; Hose, Metal, for Eliminating Compressor Vibration; Insulation, Sound Deadening

NOZZLES, SPRAY

Balloffet Dies and Nozzle Co., Inc., Guttenberg, N. J.
Bayley Blower Co., Milwaukee, Wis.
Benjamin Air Rifle Co., St. Louis, Mo.
Betz Air Conditioning Corp., Kansas City, Mo.
Binks Mfg. Co., Chicago, Ill.
Blower Application Co., Milwaukee, Wis.
●Buffalo Forge Co., Buffalo, N. Y.
Chain Belt Co., Milwaukee, Wis.
●Clarage Fan Co., Kalamazoo, Mich.
Cooling Tower Co., Inc., The, Div. of The Fluor Corp., Ltd., New York, N. Y.
DeVilbiss Co., The, Toledo, O.
Dustlix Corp., Milwaukee, Wis.
Fluor Corp., Ltd., The, Los Angeles, Cal.
Goodrich Co., B. F., Akron, O.
Howell Mfg. Co., Kansas City, Mo.
International Moistening Co., Providence, R. I.
Johnson Tool Co., East Providence, R. I.
Link-Belt Co., Chicago, Ill.
●Marley Co., Kansas City, Mo.
Martocello & Co., Jos. A., Philadelphia, Pa.
Milburn Co., Alexander, Baltimore, Md.
Monarch Mfg. Wks., Inc., Philadelphia, Pa.
Northern Indiana Brass Co., Elkhart, Ind.
Parks-Cramer Co., Fitchburg, Mass.
Penn Cooling Tower Wks., Pittsburgh, Pa.
Peterson Freezem Mfg. & Sales Co., Kansas City, Mo.
Rega Mfg. Co., Rochester, N. Y.
Ross Sprinkler Co., Pasadena, Cal.
Schubert-Christy Corp., Affton Station, St. Louis, Mo.
Schutte & Koerting Co., Philadelphia, Pa.
Skinner Irrigation Co., Troy, O.
Spence Engineering Co., Inc., Walden, N. Y.
Spray Engineering Co., Somerville, Mass.
Spraying Systems Co., Chicago, Ill.
Strandwitz & Co., Inc., W. J., Camden, N. J.
●Sturtevant Co., B. F., Boston, Mass.
Supreme Electric Products Corp., Rochester, N. Y.
●Yarnall-Waring Co., Philadelphia, Pa.

OBSERVATION PORTS, BOILER

Detroit Stoker Co., Detroit, Mich.

ODOR ADSORBERS

See Filters, Air; Adsorbers, Odor

OIL BURNERS

See Burners, Oil

OIL SEPARATORS

See Separators, Steam and Oil

OPEN END WRENCHES

See Wrenches, Open End

OPERATORS, DAMPER, DUCT

●Au-Temp-Co Corp., New York, N. Y.
●Automatic Products Co., Milwaukee, Wis.
Automatic Temperature Control Co., Inc., Philadelphia, Pa.
●Barber-Colman Co., Rockford, Ill.
Cooper Co., Clark, Philadelphia, Pa.
●Detroit Lubricator Co., Detroit, Mich.
Friez & Sons, Julien P., Baltimore, Md.
●Fulton Sylphon Co., Knoxville, Tenn.
General Controls Co., Glendale, Cal.
●Johnson Service Co., Milwaukee, Wis.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
●Powers Regulator Co., Chicago, Ill.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Young Regulator Co., Cleveland, O.

OPERATORS, VALVE

●Au-Temp-Co Corp., New York, N. Y.
Automatic Temperature Control Co., Inc., Philadelphia, Pa.
●Barber-Colman Co., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bristol Co., Waterbury, Conn.
Cooper Co., Clark, Philadelphia, Pa.
Crane Co., Chicago, Ill.
Cutler-Hammer, Inc., Milwaukee, Wis.
●Detroit Lubricator Co., Detroit, Mich.
●Fulton Sylphon Co., Knoxville, Tenn.
General Controls Co., Glendale, Cal.
●Johnson Service Co., Milwaukee, Wis.
Mason-Neilan Regulator Co., Boston, Mass.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
●Powers Regulator Co., Chicago, Ill.
R-S Products Corp., Philadelphia, Pa.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

ORIFICES, RADIATOR

Barnes & Jones, Inc., Jamaica Plain, Boston, Mass.
●Bell & Gossett Co., Chicago, Ill.
●Detroit Lubricator Co., Detroit, Mich.
●Dunham Co., C. A., Chicago, Ill.
Haines & Co., William S., Philadelphia, Pa.
Hoffman Specialty Co., Inc., Waterbury, Conn.
●Illinois Engineering Co., Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
New York Air Valve Corp., New York, N. Y.
●Sarco Co., Inc., New York, N. Y.
Spence Engineering Co., Inc., Walden, N. Y.
Thrush & Co., H. A., Peru, Ind.
●Trane Co., La Crosse, Wis.
●Webster & Co., Warren, Camden, N. J.

OXY-ACETYLENE WELDING

See Welding and Cutting Apparatus, Oxy-Acetylene

OZONE APPARATUS

American Hydrozone Co., Inc., New York, N. Y.
Automatic Pump & Softener Corp., Rockford, Ill.
Chelsea Fan & Blower Co., New York, N. Y.
Corozone Air Conditioning Corp., Cleveland, O.
Electroaire Corp., Chicago, Ill.

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Kisco Co., Inc., St. Louis, Mo.
Lohman, Inc., Wm. J., New York, N. Y.
Montgomery Bros., San Francisco, Cal.
Norwood Filtration Co., The, Florence, Mass.
Ozo-Ray Process Corp., Chicago, Ill.
Sealkote Corp., Chicago, Ill.
United States Ozone Co. of America, Scottdale, Pa.

PACKING, ASBESTOS

Acme Asbestos Coverings & Flooring Co., Chicago, Ill.
Allpax Co., Inc., Mamaroneck, N. Y.
Anchor Packing Co., Philadelphia, Pa.
Austin-Mason Co., New York, N. Y.
Belmont Packing & Rubber Co., Philadelphia, Pa.
●Carey Co., Philip, Lockland, Cincinnati, O.
Chicago Specialty Mfg. Co., Chicago, Ill.
Crane Packing Co., Chicago, Ill.
Darcoid Co., Inc., New York, N. Y.
Durabla Mfg. Co., New York, N. Y.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Felt Products Mfg. Co., Chicago, Ill.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.
Greene, Tweed & Co., New York, N. Y.
Jenkins Bros., New York, N. Y.
Johns-Manville, New York, N. Y.
Keasbey Co., Robert A., New York, N. Y.
Keasbey & Mattison Co., Ambler, Pa.
Klingerit, Inc., New York, N. Y. (Sheet & rod)
Metallo Gasket Co., New Brunswick, N. J.
Pacific States Felt & Mfg. Co., Inc., San Francisco, Cal.
Sall Mountain Co., Chicago, Ill.
Union Asbestos & Rubber Co., Cicero, Ill.

PACKING, FIBER

Anchor Packing Co., Philadelphia, Pa.
Austin-Mason Co., New York, N. Y.
Belmont Packing & Rubber Co., Philadelphia, Pa.
Darcoid Co., Inc., New York, N. Y.
Durabla Mfg. Co., New York, N. Y.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Endura Mfg. Corp., Quakertown, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.
Jenkins Bros., New York, N. Y.
Johns-Manville, New York, N. Y.
Keasbey Co., Robert A., New York, N. Y.
●McQuay-Norris Mfg. Co., St. Louis, Mo.
Metallo Gasket Co., New Brunswick, N. J.
Pacific States Felt & Mfg. Co., Inc., San Francisco, Cal.
Paxtix, Inc., Chicago, Ill.
Union Asbestos & Rubber Co., Cicero, Ill.

PACKING, LEATHER

Alexander Bros., Philadelphia, Pa.
Belmont Packing & Rubber Co., Philadelphia, Pa.
Chicago Belting Co., Chicago, Ill.
Excelsior Leather Washer Co., Rockford, Ill.
Graton & Knight Co., Worcester, Mass.
Houghton & Co., E. F., Philadelphia, Pa.
Pacific States Felt & Mfg. Co., Inc., San Francisco, Cal.
●Rhoads & Sons, J. E., Philadelphia, Pa.
Williams & Son, I. B., Dover, N. H.

PACKING, METALLIC

Aeco Packing Products Co., Chicago, Ill.
Allpax Co., Inc., Mamaroneck, N. Y.
Alpha Metal & Rolling Mills, Inc., Brooklyn, N. Y.
Anchor Packing Co., Philadelphia, Pa.
Austin-Mason Co., New York, N. Y.
Belmont Packing & Rubber Co., Philadelphia, Pa.
Conneaut Packing Co., Conneaut, O.
Crane Packing Co., Chicago, Ill.
Darcoid Co., Inc., New York, N. Y.
Felt Products Mfg. Co., Chicago, Ill.
France Packing Co., Tacony, Philadelphia, Pa.
Garlock Packing Co., Palmyra, N. Y.
Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.
Hound Packing Co., Chicago, Ill.
Johns-Manville, New York, N. Y.
Klingerit, Inc., New York, N. Y. (Sheet & rod)
●McQuay-Norris Mfg. Co., St. Louis, Mo.
National Engineering Products, Inc., Washington, D. C.
Pacific States Felt & Mfg. Co., Inc., San Francisco, Cal.
Rotary Seal Co., Chicago, Ill.
Union Asbestos & Rubber Co., Cicero, Ill.

PACKING, RUBBER

Anchor Packing Co., Philadelphia, Pa.
Austin-Mason Co., New York, N. Y.
Belmont Packing & Rubber Co., Philadelphia, Pa.
Boston Woven Hose & Rubber Co., Cambridge, Mass.
Chicago Specialty Mfg. Co., Chicago, Ill.
Continental Rubber Wks., Erie, Pa.
Crane Packing Co., Chicago, Ill.
Darcoid Co., Inc., New York, N. Y.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Garlock Packing Co., Palmyra, N. Y.
Gates Rubber Co., Denver, Colo.
Goodrich Co., B. F., Akron, O.
Goodyear Tire & Rubber Co., Akron, O.
Hamilton Rubber Mfg. Co., Trenton, N. J.
Jenkins Bros., New York, N. Y.
Johns-Manville, New York, N. Y.
Manhattan Rubber Mfg. Co., Div. of Raybestos-Manhattan Inc., Passaic, N. J.
Miller Rubber Co., Inc., Akron, O.
Pacific States Felt & Mfg. Co., Inc., San Francisco, Cal.
Republic Rubber Div., Lee Rubber & Tire Corp., Youngstown, O.
Resistoflex Corp., Belleville, N. J. (Synthetic resin)
Union Asbestos & Rubber Co., Cicero, Ill.
United States Rubber Co., New York, N. Y.

PILLOW BLOCK BEARINGS

See Bearings, Pillow Block

PIPE, ASBESTOS FIBER AND CEMENT

Johns-Manville, New York, N. Y.
Keasbey & Mattison Co., Ambler, Pa.
Union Asbestos & Rubber Co., Cicero, Ill.

PIPE BENDERS

See Benders, Pipe

PIPE, BRASS AND COPPER

●American Brass Co., Waterbury, Conn.
American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Bridgeport Brass Co., Bridgeport, Conn.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Hussey & Co., C. G., Pittsburgh, Pa.
●Mueller Brass Co., Port Huron, Mich.
Revere Copper & Brass, Inc., New York, N. Y.
Scovill Mfg. Co., Waterville Div., Waterville, Conn.
●Streamline Pipe & Fittings Div., Mueller Brass Co., Port Huron, Mich.
United States Brass & Copper Co., Hyde Park, Boston, Mass.
Wolverine Tube Co., Detroit, Mich.

PIPE, CARBON

National Carbon Co., Cleveland, O.

PIPE, CAST IRON, PRESSURE, BELL AND SPIGOT

Alabama Pipe Co., Anniston, Ala.
American Cast Iron Pipe Co., Birmingham, Ala.
Central Foundry Co., New York, N. Y.
Clow & Sons, James B., Chicago, Ill.
Inner-Tite Clamp Corp., Elizabeth, N. J.
Lynchburg Foundry Co., Lynchburg, Va.
McWane Cast Iron Pipe Co., Birmingham, Ala.
National Machine Wks., Chicago, Ill.
U. S. Pipe & Fdry. Co., Burlington, N. J.
Warren Foundry & Pipe Corp., New York, N. Y.

PIPE, CAST IRON, PRESSURE, FLANGED

Alabama Pipe Co., Anniston, Ala.
American Cast Iron Pipe Co., Birmingham, Ala.
Central Foundry Co., New York, N. Y.
Clow & Sons, James B., Chicago, Ill.
Inner-Tite Clamp Corp., Elizabeth, N. J.
Lynchburg Foundry Co., Lynchburg, Va.
McWane Cast Iron Pipe Co., Birmingham, Ala.
National Machine Wks., Chicago, Ill.
U. S. Pipe & Fdry. Co., Burlington, N. J.
Warren Foundry & Pipe Corp., New York, N. Y.

PIPE, CAST IRON, THREADED

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Central Foundry Co., New York, N. Y.
Clow & Sons, James B., Chicago, Ill.
McWane Cast Iron Pipe Co., Birmingham, Ala.
Somerville Iron Wks., Somerville, N. J.
U. S. Pipe & Foundry Co., Burlington, N. J.
Walworth Co., New York, N. Y.

PIPE COUPLINGS

See Couplings, Pipe

PIPE CUTTERS

See Cutters

PIPE CUTTING MACHINES

See Machines, Pipe Cutting and Threading

PIPE EXTRACTORS

See Extractors, Pipe

PIPE FITTINGS

See Fittings, Pipe

PIPE AND FITTINGS, HARD RUBBER

American Hard Rubber Co., New York, N. Y.
Goodrich Co., B. F., Akron, O.
Luzerne Rubber Co., Trenton, N. J. (Hard rubber)
Stokes Rubber Co., Jos., Trenton, N. J.
United States Rubber Co., New York, N. Y.

PIPE AND FITTINGS, JACKETED

Parks-Cramer Co., Fitchburg, Mass.

PIPE AND FITTINGS, STONEWARE

Continental Diamond Fibre Co., Newark, Del. (Molded plastic)
General Ceramics Co., New York, N. Y.
Knight, Maurice A., Akron, O. (Stoneware)
U. S. Stoneware Co., New York, N. Y. (Stoneware)

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PIPE FLANGES
See Flanges, Pipe

PIPE, GLASS
Corning Glass Wks., Corning, N. Y.

PIPE HANGERS
See Hangers and Supports, Pipe

PIPE JOINT COMPOUNDS
See Cement and Compounds, Pipe Joint

PIPE INSULATION
See Insulation, Pipe

PIPE, LEAD
Alpha Metal & Rolling Mills, Inc., Brooklyn, N. Y.
Andrews Lead Co., Long Island City, N. Y.
Belmont Smelting & Refining Wks., Inc., Brooklyn, N. Y.
Eagle-Picher Lead Co., Cincinnati, O.
Flemm Lead Co., Inc., Long Island City, N. Y.
Lissberger & Son, Inc., Marks, Long Island City, N. Y.
National Lead Co., New York, N. Y.

PIPE, LINED
Alpha Metal & Rolling Mills, Inc., Brooklyn, N. Y.
●American Brass Co., Waterbury, Conn. (Tin)
American Cast Iron Pipe Co., Birmingham, Ala. (Cement)
American Hard Rubber Co., New York, N. Y. (Rubber)
Cohoes Rolling Mill Co., Cohoes, N. Y. (Cement)
Goodrich Co., B. F., Akron, O. (Rubber-lined)
Jones & Laughlin Steel Corp., Pittsburgh, Pa. (Cement)
Lead Lined Iron Pipe Co., Wakefield, Mass. (Lead and tin lined)
Luzerne Rubber Co., Trenton, N. J. (Hard rubber)
Manhattan Rubber Mfg. Co. Div. of Raybestos-Manhattan, Inc., Passaic, N. J. (Rubber)
National Lead Co., New York, N. Y. (Lead)
National Tube Co., United States Steel Corp. Sub., Pittsburgh, Pa. (Cement)
Public Works Supply Co., Lynn, Mass. (Cement)
●Republic Steel Corp., Cleveland, O. (Cement)
Resisto Pipe & Valve Co., East Cambridge, Mass. (Lead)
United States Rubber Co., New York, N. Y. (Rubber)
Vitreous Enameling & Stamping Co., New York, N. Y. (Enamel)
Warren Foundry & Pipe Corp., New York, N. Y. (Cement-bituminous enamel)
●Youngstown Sheet & Tube Co., Youngstown, O.

PIPE LINE STRAINERS
See Strainers, Pipe Line

PIPE NIPPLES
See Nipples, Pipe

PIPE REAMERS
See Reamers, Pipe

PIPE REPAIR CLAMPS
See Clamps, Pipe Repair

PIPE, SPIRAL, RIVETED AND WELDED
●American Rolling Mill Co., The, Middletown, O.
Naylor Pipe Co., Chicago, Ill.
Taylor Forge & Pipe Wks., Chicago, Ill.

PIPE, STEEL, BUTT AND LAP WELDED
●American Rolling Mill Co., The, Middletown, O.
Bethlehem Steel Co., Bethlehem, Pa.
●Byers Co., A. M., Pittsburgh, Pa.
Central Tube Co., Pittsburgh, Pa.
Cohoes Rolling Mill Co., Cohoes, N. Y.
Fretz-Moon Tube Co., Butler, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Laclede Steel Co., St. Louis, Mo.
National Tube Co., United States Steel Corp. Sub., Pittsburgh, Pa.
Pittsburgh Tube Co., Pittsburgh, Pa.
●Republic Steel Corp., Cleveland, O.
South Chester Tube Co., Chester, Pa.
Spang Chalfant, Inc., Div. of National Supply Co., Pittsburgh, Pa.
Taylor Forge & Pipe Wks., Chicago, Ill.
Wheatland Tube Co., Philadelphia, Pa.
Wheeling Steel Corp., Wheeling, W. Va.
●Youngstown Sheet & Tube Co., Youngstown, O.

PIPE, STEEL, SEAMLESS
Bethlehem Steel Co., Bethlehem, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
National Tube Co., United States Steel Corp. Sub., Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Spang Chalfant, Inc., Div. of National Supply Co., Pittsburgh, Pa.
●Youngstown Sheet & Tube Co., Youngstown, O.

PIPE, STEEL, STAINLESS
Alloy Steel Products Co., Linden, N. J.
●American Rolling Mill Co., The, Middletown, O.
National Tube Co., United States Steel Corp. Sub., Pittsburgh, Pa.
●Republic Steel Corp., Cleveland, O.

PIPE SUPPORTS
See Hangers and Supports, Pipe

PIPE TONGS
See Tongs, Pipe

PIPE VISES
See Vises, Pipe

PIPE, WOOD
●American District Steam Co., North Tonawanda, N. Y.
Caldwell Co., W. E., Louisville, Ky.
Michigan Pipe Co., Bay City, Mich.
Wyckoff & Son Co., A., Elmira, N. Y.

PIPE WRENCHES
See Wrenches, Pipe

PIPE, WROUGHT IRON
●Byers Co., A. M., Pittsburgh, Pa.
Cohoes Rolling Mill Co., Cohoes, N. Y.
South Chester Tube Co., Chester, Pa.

PISTON RINGS
See Rings, Piston

PITOT TUBES
See Tubes, Pitot

PITTSBURGH LOCK FORMING MACHINES
See Machines, Pittsburgh Lock Forming

PLATES, FLOOR AND CEILING
American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Beaton & Cadwell Mfg. Co., New Britain, Conn.
Beaton & Corbin Mfg. Co., Southington, Conn.
Chicago Nipple Mfg. Co., Chicago, Ill.
Farley Sleeve & Hanger Co., Cleveland, O.
Fee & Mason Mfg. Co., Inc., New York, N. Y.
Globe Machine & Stamping Co., Cleveland, O.
Grabler Mfg. Co., Cleveland, O.
●Grinnell Co., Inc., Providence, R. I.
Jarecki Mfg. Co., Erie, Pa.
Keeney Mfg. Co., Newington, Conn.
Little Mfg. Co., M. S., Hartford, Conn.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Ravena Iron Co., Ravena, N. Y.
Russell Mfg. Co., John M., Naugatuck, Conn.

PLUG COCKS
See Valves, Plug

PLUG VALVES
See Valves, Plug

POWER SHEARS
See Shears, Power

PREHEATERS, FUEL OIL
●American District Steam Co., North Tonawanda, N. Y.
American Locomotive Co., Alco Products Div., New York, N. Y.
●Bell & Gossett Co., Chicago, Ill.
Davis Engineering Corp., Elizabeth, N. J.
Engineer Co., New York, N. Y.
General Fittings Co., Providence, R. I.
Griscom-Russell Co., New York, N. Y.
Hynes Electric Heating Co., Philadelphia, Pa.
Johnson Corp., Three Rivers, Mich.
National Pipe Bending Co., New Haven, Conn.
●Patterson-Kelley Co., Inc., East Stroudsburg, Pa.
Richmond Engineering Co., Inc., Richmond, Va.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Staples & Pfeiffer, Ltd., San Francisco, Cal.
Taco Heaters, Inc., New York, N. Y.
Trent Co., Harold E., Philadelphia, Pa.
Viscostat Co., Chicago, Ill.
Vulcan Electric Co., Lynn, Mass.
Warren Electric Appliance Co., Warren, Pa.
Whitlock Coil Pipe Co., Hartford, Conn.
●Wiegand Co., Edwin L., Pittsburgh, Pa.

PREHEATERS AND STRESS RELIEVERS, ELECTRIC, FOR PIPE WELDS
Kuhlman Electric Co., Detroit Electric Furnace Div., Bay City, Mich.
Swoboda, Inc., H. O., New Brighton, Pa.
Trent Co., Harold E., Philadelphia, Pa.

PRESSURE BLOWERS
See Blowers, High Pressure

PRESSURE CONTROLLERS
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PRESSURE GAGES
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PRESSURE INDICATOR-CONTROLLERS
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PRESSURE RECORDER-CONTOLLERS

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PRESSURE RECORDERS

See Recorders, Pressure and Vacuum

PRESSURE REDUCING VALVES

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PRESSURE REGULATING VALVES

See Valves, Pressure Reducing and Regulating

PRESSURE REGULATORS

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PRESSURE SWITCHES

See Switches, Pressure and Vacuum

PROCESS HEATING SYSTEMS

See Systems, Process Heating, High Temperature

PROCESS STEAM SUPERHEATERS

See Superheaters, Process Steam

PROCESS AND STORAGE TANKS

See Tanks, Process and Storage

PROPELLER FANS

See Fans, Propeller

PROTECTORS, PIPE COVERING

Carpenter & Paterson, Inc., East Boston, Mass.
Cheney Co., Philadelphia, Pa.
●Grinnell Co., Inc., Providence, R. I.

PSYCHROMETERS, SLING AND HAND ASPIRATED

Friez & Sons, Julien P., Baltimore, Md.
G. M. Mfg. Co., New York, N. Y.
H-B Instrument Co., Philadelphia, Pa.
Hill, E. Vernon, Chicago, Ill.
●Johnson Service Co., Milwaukee, Wis.
Moeller Instrument Co., Richmond Hill, N. Y.
Palmer Co., Cincinnati (Norwood), O.
Parks-Cramer Co., Fitchburg, Mass.
Precision Thermometer & Instrument Co., Philadelphia, Pa.
Scientific Instrument Co., Detroit, Mich.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.

PSYCHROSTATS

See Humidistats

PUMP BASES

See Bases and Pads, Vibration Isolating

PUMPS, BOILER FEED

Aldrich Pump Co., Allentown, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Aurora Pump Co., Aurora, Ill.
Austin-Mason Co., New York, N. Y.
Berns Specialty Co., Chicago, Ill.
●Buffalo Pumps, Inc., Buffalo, N. Y.
Chicago Pump Co., Chicago, Ill.
Cissell Mfg. Co., W. M., Louisville, Ky.
Columbus Steam Pump Wks. Co., Columbus, O.
Davidson Co., M. T., New York, N. Y.
Dayton-Dowd Co., Quincy, Ill.
Dean Bros. Co., Indianapolis, Ind.
Dean Hill Pump Co., Anderson, Ind.
Decatur Pump Co., Decatur, Ill.
Deming Co., Salem, O.
Eclipse Fuel Engineering Co., Rockford, Ill
Economy Pumps, Inc., Chicago, Ill.
Everite Pump & Mfg. Co., Inc., Lancaster, Pa.
Fairbanks, Morse & Co., Chicago, Ill.
Foster Pump Works, Inc., Brooklyn, N. Y.
Foster Wheeler Corp., New York, N. Y.
Frederick Iron & Steel Co., Frederick, Md.
Gardner-Denver Co., Quincy, Ill.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Guild & Garrison, Inc., Brooklyn, N. Y.
Ingersoll-Rand, New York, N. Y.
Johnson Corp., Three Rivers, Mich.
Kingsford Foundry & Machine Wks., Oswego, N. Y.
Kisco Boiler & Engineering Co., St. Louis, Mo.
Kraissl Co., Inc., The, Hackensack, N. J.
Lawrence Pump & Engine Co., Lawrence, Mass.
Lecourtenay Co., Newark, N. J.
McGowan Co., John H., Cincinnati, O.
Micro-Westco, Inc., Bettendorf, Ia.
Morehead Mfg. Co., Detroit, Mich.
Morris Machine Works, Baldwinsville, N. Y.
Myers & Bro. Co., F. E., The, Ashland, O.
●Nash Engineering Co., South Norwalk, Conn.
National Steam Pump Co., Upper Sandusky, O.
Roots-Connersville Blower Corp., Connersville, Ind.
Rumsey Pump Corp., Seneca Falls, N. Y.
Schaub Engineering Co., Fred H., Chicago, Ill.
Sterling Engineering & Mfg. Corp., Hyde Park, Mass.
Swaby Mfg. Co., Chicago, Ill.
Union Steam Pump Co., Battle Creek, Mich.
Warren Steam Pump Co., Inc., Warren, Mass.
Weil Pump Co., Chicago, Ill.
Weinman Pump Co., Columbus, O.
●Worthington Pump & Machinery Corp., Harrison, N. J.
Yeomans Bros. Co., Chicago, Ill.

PUMPS, CENTRIFUGAL

Aldrich Pump Co., Allentown, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American-Marsh Pumps, Inc., Battle Creek, Mich.
American Well Wks., Aurora, Ill.
Aurora Pump Co., Aurora, Ill.
Austin-Mason Co., New York, N. Y.
Barrett, Haentjens & Co., Hazleton, Pa.
Beach-Russ Co., New York, N. Y.
Berns Specialty Co., Chicago, Ill.
Blaisdell Compressor Co., New York, N. Y.
●Buffalo Pumps, Inc., Buffalo, N. Y.
Byron Jackson Co., Los Angeles, Cal.
Chain Belt Co., Milwaukee, Wis.
Chicago Pump Co., Chicago, Ill.
Columbus Steam Pump Wks. Co., Columbus, O.
Davidson Co., M. T., New York, N. Y.
Dayton-Dowd Co., Quincy, Ill.
Dean Bros. Co., Indianapolis, Ind.
Dean Hill Pump Co., Anderson, Ind.
Decatur Pump Co., Decatur, Ill.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., Salem, O.
Domestic Engine & Pump Co., New York, N. Y.
●Dunham Co., C. A., Chicago, Ill.
Economy Pumps, Inc., Chicago, Ill.
Everite Pump & Mfg. Co., Inc., Lancaster, Pa.
Fairbanks, Morse & Co., Chicago, Ill.
Foster Pump Works, Inc., Brooklyn, N. Y.
Foster Wheeler Corp., New York, N. Y.
Frederick Iron & Steel Co., Frederick, Md.
Fulflo Specialties Co., Inc., The, Blanchester, O.
Gardner-Denver Co., Quincy, Ill.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Guild & Garrison, Inc., Brooklyn, N. Y.
Hammett Mfg. Co., Kansas City, Mo.
Ingersoll-Rand, New York, N. Y.
Kimball-Krogh Pump Div., Food Machinery Corp., Los Angeles, Cal.
Kingsford Foundry & Machine Wks., Oswego, N. Y.
Kraissl Co., Inc., The, Hackensack, N. J.
La Bour Pump Co., Inc., Elkhart, Ind.
Lawrence Pump & Engine Co., Lawrence, Mass.
Lecourtenay Co., Newark, N. J.
Lewis & Co., Inc., Chas. S., St. Louis, Mo.
Luzerne Rubber Co., Trenton, N. J. (Hard rubber)
McGowan Co., John H., Cincinnati, O.
Micro-Westco, Inc., Bettendorf, Ia.
Morris Machine Wks., Baldwinsville, N. Y.
Myers & Bro. Co., F. E., The, Ashland, O.
●Nash Engineering Co., South Norwalk, Conn.
Oberdorfer Brass Co., M. L., Syracuse, N. Y.
Palmer Electric Co., Detroit, Mich.
Pennsylvania Pump & Compressor Co., Easton, Pa.
Quimby Pump Co., Inc., Newark, N. J.
Red Jacket Mfg. Co., Davenport, Ia.
Rumsey Pump Corp., Seneca Falls, N. Y.
Schneible Co., Claude B., Chicago, Ill.
Switzer-Cummins Co., Indianapolis, Ind.
Smith Meter Co., Los Angeles, Cal.
Swaby Mfg. Co., Chicago, Ill.
Taber Pump Co., Buffalo, N. Y.
●Trane Co., La Crosse, Wis.
Union Steam Pump Co., Battle Creek, Mich.
United Motors Service Co., Detroit, Mich.
Utility Fan Corp., Los Angeles, Cal.
Warren Steam Pump Co., Inc., Warren, Mass.
Weil Pump Co., Chicago, Ill.
Weinman Pump Mfg. Co., Columbus, O.
●Worthington Pump & Machinery Corp., Harrison, N. J.
Yeomans Bros. Co., Chicago, Ill.

PUMPS, CONDENSATION RETURN

Aldrich Pump Co., Allentown, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Aurora Pump Co., Aurora, Ill.
●Buffalo Pumps, Inc., Buffalo, N. Y.
Byron Jackson Co., Los Angeles, Cal.
Chicago Pump Co., Chicago, Ill.
Cissell Mfg. Co., W. M., Louisville, Ky.
Columbus Steam Pump Wks. Co., Columbus, O.
Davidson Co., M. T., New York, N. Y.
Dayton-Dowd Co., Quincy, Ill.
Dean Bros. Co., Indianapolis, Ind.
Dean Hill Pump Co., Anderson, Ind.
Decatur Pump Co., Decatur, Ill.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., Salem, O.
Domestic Engine & Pump Co., New York, N. Y.
●Dunham Co., C. A., Chicago, Ill.
Eclipse Fuel Engineering Co., Rockford, Ill.
Economy Pumps, Inc., Chicago, Ill.
Fairbanks, Morse & Co., Chicago, Ill.
Foster Pump Works, Inc., Brooklyn, N. Y.
Foster Wheeler Corp., New York, N. Y.
Frederick Iron & Steel Co., Frederick, Md.
Goulds Pumps, Inc., Seneca Falls, N. Y.

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Guild & Garrison, Inc., Brooklyn, N. Y.
Heating Assurance, Inc., Spokane, Wash.
Hoffman Specialty Co., Inc., Waterbury, Conn.
Ingersoll-Rand, New York, N. Y.
Johnson Corp., Three Rivers, Mich.
Kisco Boiler & Engineering Co., St. Louis, Mo.
Lawrence Pump & Engine Co., Lawrence, Mass.
Lecourtenay Co., Newark, N. J.
Lewis & Co., Inc., Chas. S., St. Louis, Mo.
McGowan Co., John H., Cincinnati, O.
Micro-Westco, Inc., Bettendorf, Ia.
Morehead Mfg. Co., Detroit, Mich.
Myers & Bro. Co., F. E., The, Ashland, O.
●Nash Engineering Co., South Norwalk, Conn.
National Steam Pump Co., Upper Sandusky, O.
Oberdorfer Brass Co., M. L., Syracuse, N. Y.
Quimby Pump Co., Inc., Newark, N. J.
Roots-Connersville Blower Corp., Connersville, Ind.
Rumsey Pump Corp., Seneca Falls, N. Y.
Schaub Engineering Co., Fred H., Chicago, Ill.
Skidmore Corp., St. Joseph, Mo.
Sterling Engineering Co., Milwaukee, Wis.
Sterling Engineering & Mfg. Corp., Hyde Park, Mass.
Swaby Mfg. Co., Chicago, Ill.
●Trane Co., La Crosse, Wis.
Warren Steam Pump Co., Inc., Warren, Mass.
Weil Pump Co., Chicago, Ill.
Weinman Pump Co., Columbus, O.
Wheeler Mfg. Co., C. H., Philadelphia, Pa.
●Worthington Pump & Machinery Corp., Harrison, N. J.
Yeomans Bros. Co., Chicago, Ill.

PUMPS, DEEP WELL, TURBINE

American-Marsh Pumps, Inc., Battle Creek, Mich.
American Well Wks., Aurora, Ill.
Aurora Pump Co., Aurora, Ill.
Caldwell, Farley M., Fort Wayne, Ind.
Columbus Steam Pump Wks. Co., Columbus, O.
Cook, Inc., A. D., Lawrenceburg, Ind.
Davidson Co., M. T., New York, N. Y.
Deming Co., Salem, O.
Duro Co., Dayton, O.
Everite Pump & Mfg. Co., Inc., Lancaster, Pa.
Fairbanks, Morse & Co., Chicago, Ill.
Goulds Pumps, Inc., Seneca, N. Y.
Guild & Garrison, Inc., Brooklyn, N. Y.
Ingersoll-Rand, New York, N. Y.
Kimball-Krogh Pump Div., Food Machinery Corp., Los Angeles, Cal.
Layne & Bowler, Inc., Memphis, Tenn.
Micro-Westco, Inc., Bettendorf, Ia. (Jet type)
Peerless Pump Div., Food Machinery Corp., Massillon, O.
Pomona Pump Co., Pomona, Cal.
Red Jacket Mfg. Co., Davenport, Ia.
Roper Corp., Geo. D., Rockford, Ill.
Rumsey Pump Corp., Seneca Falls, N. Y.
Uniflow Mfg. Co., Erie, Pa.
●Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS, FIRE

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American-Marsh Pumps, Inc., Battle Creek, Mich.
●Buffalo Pumps, Inc., Buffalo, N. Y.
Chicago Pump Co., Chicago, Ill.
Dayton-Dowd Co., Quincy, Ill.
Economy Pumps, Inc., Chicago, Ill.
Fairbanks, Morse & Co., Chicago, Ill.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Guild & Garrison, Inc., Brooklyn, N. Y.
Ingersoll-Rand, New York, N. Y.
Lecourtenay Co., Newark, N. J.
McGowan Co., John H., Cincinnati, O.
Morris Machine Wks., Baldwinsville, N. Y.
Oberdorfer Brass Co., M. L., Syracuse, N. Y.
Pennsylvania Pump & Compressor Co., Easton, Pa.
Rumsey Pump Corp., Seneca Falls, N. Y.
Viking Pump Co., Cedar Falls, Ia.
●Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS, RECIPROCATING

Aldrich Pump Co., Allentown, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Alten's Foundry & Machine Works, Lancaster, O.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Austin-Mason Co., New York, N. Y.
●Buffalo Pumps, Inc., Buffalo, N. Y.
Columbus Steam Pump Wks., Columbus, O.
Davidson Co., M. T., New York, N. Y.
Dean Bros. Co., Indianapolis, Ind.
Deming Co., Salem, O.
Domestic Engine & Pump Co., New York, N. Y.
Everite Pump & Mfg. Co., Inc., Lancaster, Pa.
Fairbanks, Morse & Co., Chicago, Ill.
Foster Pumps Wks., Inc., Brooklyn, N. Y.
Gardner-Denver Co., Quincy, Ill.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Guild & Garrison, Inc., Brooklyn, N. Y.
Hammett Mfg. Co., Kansas City, Mo.
Homestead Valve Mfg. Co., Coraopolis, Pa.
Ingersoll-Rand, New York, N. Y.
McGowan Co., John H., Cincinnati, O.
National Steam Pump Co., Upper Sandusky, O.
Red Jacket Mfg. Co., Davenport, Ia.
Rumsey Pump Corp., Seneca Falls, N. Y.
Uniflow Mfg. Co., Erie, Pa.
Union Steam Pump Co., Battle Creek, Mich.
Weinman Pump Co., Columbus, O.
●Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS, ROTARY

American Hard Rubber Co., New York, N. Y. (Hard Rubber)
Beach-Russ Co., New York, N. Y.
Blackmer Pump Co., Grand Rapids, Mich.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Davidson Co., M. T., New York, N. Y.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., Salem, O.
Fairbanks, Morse & Co., Chicago, Ill.
Foster Pump Wks., Inc., Brooklyn, N. Y.
Gardner-Denver Co., Quincy, Ill.
Gould Pumps, Inc., Seneca Falls, N. Y.
Kinney Mfg. Co., Boston, Mass.
Kraissl Co., Inc., The, Hackensack, N. J.
Logan Engineering Co., Chicago, Ill. (Radial diaphragm)
Martocello & Co., Jos. A., Philadelphia, Pa.
McGowan Co., John H., Cincinnati, O.
Monarch Mfg. Wks., Inc., Philadelphia, Pa.
●Nash Engineering Co., South Norwalk, Conn.
Oberdorfer Brass Co., M. L., Syracuse, N. Y.
Quimby Pump Co., Inc., Newark, N. J.
Red Jacket Mfg. Co., Davenport, Ia.
Roots-Connersville Blower Corp., Connersville, Ind.
Roper Corp., Geo. D., Rockford, Ill.
Rumsey Pump Corp., Seneca Falls, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
Sundstrand Machine Tool Co., Rockford, Ill.
Taber Pump Co., Buffalo, N. Y.
Trimount Rotary Power Co., East Dedham, Mass.
Tuthill Pump Co., Chicago, Ill.
Viking Pump Co., Cedar Falls, Ia.
●Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS, STEAM

Alten's Foundry & Machine Works, Lancaster, O.
American-Marsh Pumps, Inc., Battle Creek, Mich.
Austin-Mason Co., New York, N. Y.
●Buffalo Pumps, Inc., Buffalo, N. Y.
Columbus Steam Pump Wks. Co., Columbus, O.
Davidson Co., M. T., New York, N. Y.
Dean Bros. Co., Indianapolis, Ind.
Domestic Engine & Pump Co., New York, N. Y.
Fairbanks, Morse & Co., Chicago, Ill.
Foster Pump Wks., Inc., Brooklyn, N. Y.
Gardner-Denver Co., Quincy, Ill.
Guild & Garrison, Inc., Brooklyn, N. Y.
Ingersoll-Rand, New York, N. Y.
McGowan Co., John H., Cincinnati, O.
National Steam Pump Co., Upper Sandusky, O.
Sterling Engineering & Mfg. Corp., Hyde Park, Mass.
Union Steam Pump Co., Battle Creek, Mich.
Warren Steam Pump Co., Inc., Warren, Mass.
Weinman Pump Co., Columbus, O.
●Worthington Pump & Machinery Corp., Harrison, N. J.

PUMPS, SUMP

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American-Marsh Pumps, Inc., Battle Creek, Mich.
American Well Wks., Aurora, Ill.
Aurora Pump Co., Aurora, Ill.
Austin-Mason Co., New York, N. Y.
●Buffalo Pumps, Inc., Buffalo, N. Y.
Chicago Pneumatic Tool Co., New York, N. Y.
Chicago Pump Co., Chicago, Ill.
Columbus Steam Pump Wks. Co., Columbus, O.
Davidson Co., M. T., New York, N. Y.
Dayton-Dowd Co., Quincy, Ill.
Dean Hill Pump Co., Anderson, Ind.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., Salem, O.
Domestic Engine & Pump Co., New York, N. Y.
Economy Pumps, Inc., Chicago, Ill.
Everite Pump & Mfg. Co., Inc., Lancaster, Pa.
Fairbanks, Morse & Co., Chicago, Ill.
Foster Pump Wks., Inc., Brooklyn, N. Y.
Frederick Iron & Steel Co., Frederick, Md.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Guild & Garrison, Inc., Brooklyn, N. Y.
Imperial Brass Mfg. Co., Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand, New York, N. Y.
Kimball-Krogh Pump Div., Food Machinery Corp., Los Angeles, Cal.
Kingsford Foundry & Machine Wks., Oswego, N. Y.
Kisco Boiler & Engineering Co., St. Louis, Mo.
Lawrence Pump & Engine Co., Lawrence, Mass.
McGowan Co., John H., Cincinnati, O.
Micro-Westco, Inc., Bettendorf, Ia.
Morris Machine Wks., Baldwinsville, N. Y.
Myers & Bro. Co., F. E., The, Ashland, O.
●Nash Engineering Co., South Norwalk, Conn.
Oberdorfer Brass Co., M. L., Syracuse, N. Y.

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Penberthy Injector Co., Detroit, Mich.
Pomona Pump Co., Pomona, Cal.
Quimby Pump Co., Inc., Newark, N. J.
Red Jacket Mfg. Co., Davenport, Ia.
Rumsey Pump Corp., Seneca Falls, N. Y.
Schneible Co., Claude B., Chicago, Ill.
Sterling Engineering & Mfg. Corp., Hyde Park, Mass.
Swaby Mfg. Co., Chicago, Ill.
Taber Pump Co., Buffalo, N. Y.
Uniflow Mfg. Co., Erie, Pa.
Union Steam Pump Co., Battle Creek, Mich.
Weil Pump Co., Chicago, Ill.
Weinman Pump Co., Columbus, O.
●Worthington Pump & Machinery Corp., Harrison, N. J.
Yeomans Bros Co., Chicago, Ill.

PUMPS, VACUUM HEATING

American-Marsh Pumps, Inc., Battle Creek, Mich.
Beach-Russ Co., New York, N. Y.
Chicago Pump Co., Chicago, Ill.
Croll-Reynolds Engineering Co., Inc., New York, N. Y.
●Dunham Co., C. A., Chicago, Ill.
Economy Pumps, Inc., Chicago, Ill.
Gardner-Denver Co., Quincy, Ill.
Guild & Garrison, Inc., Brooklyn, N. Y.
Gylstrom Co., O., Milwaukee, Wis.
Hoffman Specialty Co., Inc., Waterbury, Conn.
Ingersoll-Rand, New York, N. Y.
Johnson Corp., Three Rivers, Mich.
●Nash Engineering Co., South Norwalk, Conn.
Roots-Connersville Blower Corp., Connersville, Ind.
Skidmore Corp., St. Joseph, Mich.
Sterling Engineering Co., Milwaukee, Wis.
Sterling Engineering & Mfg. Corp., Hyde Park, Mass.
Weinman Pump Co., Columbus, O.
●Worthington Pump & Machinery Corp., Harrison, N. J.
Yeomans Bros. Co., Chicago, Ill.

PUMPS, VISCOUS LIQUIDS AND HEAVY MATERIALS

Aldrich Pump Co., Allentown, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Austin-Mason Co., New York, N. Y.
Beach-Russ Co., New York, N. Y.
●Buffalo Pumps, Inc., Buffalo, N. Y.
Chicago Pump Co., Chicago, Ill.
Columbus Steam Pump Wks. Co., Columbus, O.
Davidson Co., M. T., New York, N. Y.
Dean Bros. Co., Indianapolis, Ind.
Economy Pumps, Inc., Chicago, Ill.
Engineer Co., New York, N. Y.
Fairbanks, Morse & Co., Chicago, Ill.
Foster Pump Works, Inc., Brooklyn, N. Y.
Frederick Iron & Steel Co., Frederick, Md.
Gardner-Denver Co., Quincy, Ill.
Goulds Pumps, Inc., Seneca Falls, N. Y.
Guild & Garrison, Inc., Brooklyn, N. Y.
Ingersoll-Rand, New York, N. Y.
Kimball-Krogh Pump Div., Food Machinery Corp., Los Angeles, Cal.
Kingsford Foundry & Machine Wks., Oswego, N. Y.
Kinney Mfg. Co., Boston, Mass.
Kraissl Co., Inc., The, Hackensack, N. J.
Lawrence Pump & Engine Co., Lawrence, Mass.
McGowan Co., John H., Cincinnati, O.
Morris Machine Wks., Baldwinsville, N. Y.
Quimby Pump Co., Inc., Newark, N. J.
Roots-Connersville Blower Corp., Connersville, Ind.
Roper Corp., Geo. D., Rockford, Ill.
Rumsey Pump Corp., Seneca Falls, N. Y.
Taber Pump Co., Buffalo, N. Y.
Tuthill Pump Co., Chicago, Ill.
Union Steam Pump Co., Battle Creek, Mich.
Viking Pump Co., Cedar Falls, Ia.
●Worthington Pump & Machinery Corp., Harrison, N. J.
Yeomans Bros. Co., Chicago, Ill.

PUNCHES, SHEET METAL

Beatty Machine & Mfg. Co., Hammond, Ind.
Bertsch & Co., Inc., Cambridge City, Ind.
Bliss Co., E. W., Toledo, O.
●Buffalo Forge Co., Buffalo, N. Y.
Callahan Can Machine Co., Inc., Brooklyn, N. Y.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Excelsior Tool & Machine Co., East St. Louis, Ill.
Heartley Machine & Tool Co., Toledo, O.
Hendley & Wittemore Co., Beloit, Wis.
Henry & Wright Mfg. Co., Hartford, Conn.
International Nutyp Tool Corp., Oswego, N. Y.
Kidder Mfg. Co., Inc., J. F., Burlington, Vt.
New Albany Machine Mfg. Co., New Albany, Ind.
Niagara Machine & Tool Wks., Buffalo, N. Y.
Parker-Kalon Corp., New York, N. Y.
Peck, Stow & Wilcox Co., Southington, Conn.
Pels & Co., Inc., Henry, New York, N. Y.
Perkins Machine Co., Warren, Mass.
Rock River Machine Co., Inc., Janesville, Wis.
Royersford Foundry & Machine Co., Royersford, Pa.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Service Machine Co., Elizabeth, N. J.
Swaine Mfg. Co., Fred J., St. Louis, Mo.
Verson Allsteel Press Co., Chicago, Ill.
Whitney Mfg. Co., W. A., Rockford, Ill.
●Whitney Metal Tool Co., Rockford, Ill.
Wiedemann Machine Co., Philadelphia, Pa.
Zeh & Hahnemann Co., Newark, N. J.

QUADRANTS, DAMPER

Adams Co., The, Dubuque, Ia.
Air Control Products, Inc., Muskegon, Mich.
California Cornice, Steel & Supply Corp., Los Angeles, Cal.
Goese Mfg. Co., Milwaukee, Wis.
Hart & Cooley Mfg. Co., Chicago, Ill.
Kerentoff, G. L., Cincinnati, O.
Northern Weatherstrip Co., Duluth, Minn.
Ohio Products Co., Cleveland, O.
Parker-Kalon Corp., New York, N. Y.
United States Register Co., Battle Creek, Mich.
Young Regulator Co., Cleveland, O.

RADIATION, CONVECTION TYPE, CAST IRON

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Crane Co., Chicago, Ill.
National Radiator Co., The, Johnstown, Pa.
Richmond Radiator Co., Gas Products Div., Uniontown, Pa.
Smith Co., Inc., The, H. B. Westfield, Mass.
United States Radiator Corp., Detroit, Mich.
Utica Radiator Corp., Utica, N. Y.
Weil-McLain Co., Chicago, Ill.

RADIATION, CONVECTION TYPE, NON-FERROUS

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Bush Mfg. Co., Hartford, Conn.
Commodore Heaters Corp., New York, N. Y.
●Dunham Co., C. A., Chicago, Ill.
●G. & O. Mfg. Co., New Haven, Conn.
●Grinnell Co., Inc., Providence, R. I.
Manufacturers Fin Coil Co., Chicago, Ill.
●McCord Radiator & Mfg. Co., Detroit, Mich.
●McQuay, Inc., Minneapolis, Minn.
Modine Mfg. Co., Racine, Wis.
Pierce, Butler Radiator Corp., Syracuse, N. Y.
Rome-Turney Radiator Co., Rome, N. Y.
Shaw-Perkins Mfg. Co., Pittsburgh, Pa.
Super Radiator Corp., Minneapolis, Minn.
●Trane Co., La Crosse, Wis.
●Tuttle & Bailey, Inc., New Britain, Conn.
Vapor Car Heating Co., Inc., Chicago, Ill.
Vulcan Radiator Co., Hartford, Conn.
●Webster & Co., Warren, Camden, N. J.
●Young Radiator Co., Racine, Wis.

RADIATION, DIRECT

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
●Burnham Boiler Corp., Irvington, N. Y.
Clow & Sons, James B., Chicago, Ill. (Gas fired)
Columbia Radiator Co., McKeesport, Pa.
Crane Co., Chicago, Ill.
Fowler & Wolf Radiator Co., Norristown, Pa.
Hart & Crouse Corp., Utica, N. Y.
International Heater Co., Utica, N. Y.
Logansport Radiator Equipment Co., Logansport, Ind.
National Radiator Co., The, Johnstown, Pa.
Pierce, Butler Radiator Corp., Syracuse, N. Y.
Prox Co., Inc., Frank, Terre Haute, Ind.
Richmond Radiator Co., Gas Products Div., Uniontown, Pa.
Slater Mfg. Co., Wakefield, Mass. (Baseboard)
Smith Co., Inc., H. B., The, Westfield, Mass.
Thatcher Furnace Co., Newark, N. J.
United States Radiator Corp., Detroit, Mich.
Utica Radiator Corp., Utica, N. Y.
Weil-McLain Co., Chicago, Ill.

RADIATOR AND CONVECTOR HUMIDIFIERS

See Humidifiers for Radiators and Convectors

RADIATOR HANGERS

See Hangers or Brackets, Radiator

RADIATOR ORIFICE VALVES

See Valves, Radiator, Orifice

RADIATOR ORIFICES

See Orifices, Radiator

RADIATOR VALVES

See Valves, Radiator

RADIATORS, HUMIDIFYING

●Burnham Boiler Corp., Irvington, N. Y.
Utica Radiator Corp., Utica, N. Y.

RADIATOR VENT VALVE HUMIDIFIERS

See Humidifiers, Radiator Vent Valve

RATCHET WRENCHES

See Wrenches, Ratchet

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REAMERS, PIPE

American Pipe Tool Co., Chicago, Ill.
Armstrong Bros. Tool Co., Chicago, Ill.
Armstrong Mfg. Co., Bridgeport, Conn.
Beaver Pipe Tools, Inc., Warren, O.
Crown Die & Tool Co., Chicago, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Mueller Co., Decatur, Ill.
Nye Tool & Machine Wks., The, Chicago, Ill.
Toledo Pipe Threading Machine Co., Toledo, O.
Walworth Co., New York, N. Y.

RECIPROCATING PUMPS

See Pumps, Reciprocating

RECORDER-CONTROLLERS, COMBINED TEMPERATURE AND HUMIDITY

Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Foxboro Co., Foxboro, Mass.
Leeds & Northrup Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., Bridgeport, Conn.
Mason-Neilan Regulator Co., Boston, Mass.
●Powers Regulator Co., Chicago, Ill.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice Co., H. O., Detroit, Mich.

RECORDER-CONTROLLERS, HUMIDITY

●Barber-Colman Co., Rockford, Ill.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Foxboro Co., Foxboro, Mass.
●Johnson Service Co., Milwaukee, Wis.
Leeds & Northrup Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., Bridgeport, Conn.
Mason-Neilan Regulator Co., Boston, Mass.
●Powers Regulator Co., Chicago, Ill.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice Co., H. O., Detroit, Mich.

RECORDER-CONTROLLERS, PRESSURE

Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Defender Automatic Regulator Co., St. Louis, Mo.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice Co., H. O., Detroit, Mich.

RECORDER-CONTROLLERS, TEMPERATURE

Bailey Meter Co., Cleveland, O.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Defender Automatic Regulator Co., St. Louis, Mo.
Foxboro Co., Foxboro, Mass.
●Johnson Service Co., Milwaukee, Wis.
Leeds & Northrup Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., Bridgeport, Conn.
Marsh Corp., Jas. P., Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
●Powers Regulator Co., Chicago, Ill.
Pyrometer Instrument Co., New York, N. Y.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Thwing-Albert Instrument Co., Philadelphia, Pa.
Trerice Co., H. O., Detroit, Mich.
Wheelco Instruments Co., Chicago, Ill.

RECORDERS, CARBON DIOXIDE

Bailey Meter Co., Cleveland, O.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Defender Automatic Regulator Co., St. Louis, Mo.
Engelhard, Inc., Charles, Newark, N. J.
Foxboro Co., Foxboro, Mass.
Hays Corp., Michigan City, Ind.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
Leeds & Northrup Co., Philadelphia, Pa.
Republic Flow Meters Co., Chicago, Ill.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Uehling Instrument Co., Paterson, N. J.

RECORDERS, COMBINED TEMPERATURE AND HUMIDITY

Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
Leeds & Northrup Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., Bridgeport, Conn.
Mason-Neilan Regulator Co., Boston, Mass.
Moeller Instrument Co., Richmond Hill, N. Y.
●Powers Regulator Co., Chicago, Ill.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice Co., H. O., Detroit, Mich.

RECORDERS, DRAFT

Bacharach Industrial Instrument Co., Pittsburgh, Pa.
Bailey Meter Co., Cleveland, O.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Defender Automatic Regulator Co., St. Louis, Mo.
Foxboro Co., Foxboro, Mass.
Hays Corp., Michigan City, Ind.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., Bridgeport, Conn.
Mason-Neilan Regulator Co., Boston, Mass.
Republic Flow Meters Co., Chicago, Ill.
Uehling Instrument Co., Paterson, N. J.

RECORDERS, HUMIDITY

Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
H-B Instrument Co., Philadelphia, Pa.
Leeds & Northrup Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., Bridgeport, Conn.
Mason-Neilan Regulator Co., Boston, Mass.
Moeller Instrument Co., Richmond Hill, N. Y.
●Powers Regulator Co., Chicago, Ill.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice Co., H. O., Detroit, Mich.

RECORDERS, LIQUID LEVEL

Bailey Meter Co., Cleveland, O.
Bristol Co., Waterbury Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Builders Iron Foundry, Providence, R. I.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
Leeds & Northrup Co., Philadelphia, Pa.
Liquidometer Corp., Long Island City, N. Y.
Mason-Neilan Regulator Co., Boston, Mass.
Morey & Jones, Ltd., Los Angeles, Calif.
Republic Flow Meters Co., Chicago, Ill.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

RECORDERS, PRESSURE AND VACUUM

Ashton Valve Co., Cambridge, Mass.
Bacharach Industrial Instrument Co., Pittsburgh, Pa.
Bailey Meter Co., Cleveland, O.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Defender Automatic Regulator Co., St. Louis, Mo.
Electric Auto-Lite Co., Moto Meter Gauge & Equipment Div., La Crosse, Wis.
Foxboro Co., Foxboro, Mass.
Leeds & Northrup Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., Bridgeport, Conn.
Marsh Corp., Jas. P., Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
Moeller Instrument Co., Richmond Hill, N. Y.
Republic Flow Meters Co., Chicago, Ill.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice Co., H. O., Detroit, Mich.
Uehling Instrument Co., Paterson, N. J.
United States Gauge Co., New York, N. Y.

RECORDERS, TEMPERATURE

Bailey Meter Co., Cleveland, O.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Builders Iron Foundry, Providence, R. I.
Defender Automatic Regulator Co., St. Louis, Mo.
Electric Auto-Lite Co., Moto Meter Gauge & Equipment Div., La Crosse, Wis.
Engelhard, Inc., Charles, Newark, N. J.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
H-B Instrument Co., Philadelphia, Pa.
Leeds & Northrup Co., Philadelphia, Pa.
Liquidometer Corp., Long Island City, N. Y.

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Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., Bridgeport, Conn.
Marsh Corp., Jas. P., Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
Moeller Instrument Co., Richmond Hill, N. Y.
Palmer Co., Cincinnati (Norwood), O.
●Powers Regulator Co., Chicago, Ill.
Practical Instrument Co., Chicago, Ill.
Pyrometer Instrument Co., New York, N. Y.
Republic Flow Meters Co., Chicago, Ill.
●Sarco Co., Inc., New York, N. Y.
Standard Thermometer, Inc., Boston, Mass.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Thwing-Albert Instrument Co., Philadelphia, Pa.
Trerice Co., H. O., Detroit, Mich.
Wheelco Instruments Co., Chicago, Ill.

RECORDING THERMOMETERS

See Recorders, Temperature

REDUCERS, SPEED

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Boston Gear Wks., Inc., North Quincy, Mass.
De Laval Steam Turbine Co., Trenton, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
General Electric Co., Schenectady, N. Y.
Ideal Commutator Dresser Co., Sycamore, Ill.
Janette Mfg. Co., Chicago, Ill. (Motorized)
Jones Foundry & Machine Co., W. A., Chicago, Ill.
Link-Belt Co., Chicago, Ill.
Medart Co., St. Louis, Mo.
Morse Chain Co., Ithaca, N. Y. (Chain speed)
Philadelphia Gear Co., Philadelphia, Pa.
Poole Foundry & Machine Co., Baltimore, Md.
Smith, Inc., Winfield H., Springville, N. Y.
Star Electric Motor Co., Bloomfield, N. J.
Stephens-Adamson Mfg. Co., Aurora, Ill.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

REFRIGERANTS

Ansul Chemical Co., Marinette, Wis. (methyl chloride, sulphur dioxide)
Armour Ammonia Wks., Chicago, Ill. (ammonia)
Carbide & Carbon Chemicals Corp., New York, N. Y. (Butane, isobutane, propane, ethane)
du Pont de Nemours & Co., Inc., E. I., The, R. & H. Chemicals Dept., Wilmington, Del. (methyl chloride and methylene chloride)
du Pont de Nemours & Co., National Ammonia Div., Frankford, Philadelphia, Pa. (ammonia, sulphur dioxide, methyl chloride)
Kinetic Chemicals, Inc., Wilmington, Del. ("Freon")
Liquid Carbonic Corp., Chicago, Ill. (carbon dioxide)
Pennsylvania Salt Mfg. Co., Philadelphia, Pa. (ammonia)
Pure Carbonic, Inc., New York, N. Y. (carbon dioxide)
Solvay Sales Corp., New York, N. Y.
Virginia Smelting Co., West Norfolk, Va. (methyl chloride)

REFRIGERATING COMPRESSORS

See Compressors, Refrigerating

REFRIGERATION ACCUMULATORS

See Accumulators, Refrigeration

REFRIGERATION CONTROLS

See Valves, Refrigeration

REFRIGERATION FITTINGS

See Fittings, Refrigeration

REFRIGERATION MANIFOLDS

See Manifolds, Refrigeration

REFRIGERATION VALVES

See Valves, Refrigeration

REGISTERS

Air Control Products, Inc., Muskegon, Mich.
American Foundry & Furnace Co., Bloomington, Ill.
●Auer Register Co., Cleveland, O.
●Barber-Colman Co., Rockford, Ill.
Best Register Co., Milwaukee, Wis.
Char-Gale Mfg. Co., Minneapolis, Minn.
Diamond Mfg. Co., Wyoming, Pa.
Eckenroth Register Co., San Francisco, Cal.
Elsey Metal Specialties Co., Detroit, Mich.
Gillian Mfg. Co., Ferndale, Mich.
Hart & Cooley Mfg. Co., Chicago, Ill.
Hendrick Mfg. Co., Carbondale, Pa.
●Independent Register Co., Cleveland, O.
Knowles Mushroom Ventilator Co., Montclair, N. J.
Lamneck Products, Inc., Columbus, O.
Middleton Mfg. & Sales Co., Minneapolis, Minn.
Mueller Furnace Co., L. J., Milwaukee, Wis.
Newman Bros., Inc., Cincinnati, O.
Pacific Gas Radiator Co., Huntington Park, Cal.
Register & Grille Mfg. Co., Brooklyn, N. Y.
Roberts-Hamilton Co., Minneapolis, Minn.
Rock Island Register Co., Rock Island, Ill.
Standard Stamping & Perforating Co., Chicago, Ill.
●Tuttle & Bailey, Inc., New Britain, Conn.
United States Register Co., Battle Creek, Mich.
●Waterloo Register Co., Waterloo, Ia.

REGULATORS, AIR VELOCITY

●Johnson Service Co., Milwaukee, Wis.
●Powers Regulator Co., Chicago, Ill.

REGULATORS, DRAFT, COMBUSTION

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Askania Regulator Co., Chicago, Ill.
●Au-Temp-Co Corp., New York, N. Y.
Bailey Meter Co., Cleveland, O.
Boiler Room Equipment, Inc., New York, N. Y.
Bristol Co., Waterbury, Conn.
Brooke Engineering Co., Inc., Philadelphia, Pa.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Burrows Mfg. Co., F. A., York, Pa.
●Cash Co., A. W., Decatur, Ill.
Cole-Sullivan Engineering Co., Minneapolis, Minn.
Crew-Equipment Co., Inc., New York, N. Y.
Davis Regulator Co., Chicago, Ill.
Defender Automatic Regulator Co., St. Louis, Mo.
Engineer Co., New York, N. Y.
Field Mfg. Co., Chicago, Ill.
Foster Engineering Co., Newark, N. J.
Foster Wheeler Corp., New York, N. Y.
Foxboro Co., Foxboro, Mass.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Hagan Corp., Pittsburgh, Pa.
Hays Corp., Michigan City, Ind.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
●Illinois Engineering Co., Chicago, Ill.
Kieley & Mueller, Inc., New York, N. Y.
Leeds & Northrup Co., Philadelphia, Pa.
Locke Regulator Co., Salem, Mass.
Mason-Neilan Regulator Co., Boston, Mass.
National Brass Co., Grand Rapids, Mich.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
Pioneer Heat Regulator Div., Master Electric Co., The, Dayton, O.
Republic Flow Meters Co., Chicago, Ill. (Industrial)
Ruggles-Klingeman Mfg. Co., Salem, Mass.
Russell Electric Co., Chicago, Ill.
●Sarco Co., Inc., New York, N. Y.
Shallcross Controls, Inc., Milwaukee, Wis.
Sheer Co., H. M., Quincy, Ill.
Spence Engineering Co., Inc., Walden, N. Y.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
White-Rodgers Electric Co., St. Louis, Mo.

REGULATORS, PRESSURE, AIR

Askania Regulator Co., Chicago, Ill.
Belfield Co., H., Philadelphia, Pa.
Boylston Steam Specialty Co., Chicago, Ill.
Brooke Engineering Co., Inc., Philadelphia, Pa.
Cash Universal Regulator Co., Marshalltown, Ia.
Cooper Co., Clark, Philadelphia, Pa.
Davis Regulator Co., Chicago, Ill.
Defender Automatic Regulator Co., St. Louis, Mo.
d'Este Co., Julian, Charlestown, Mass.
DeVilbiss Co., The, Toledo, O.
Dockson Co., C. H., Detroit, Mich.
Fisher Governor Co., Marshalltown, Ia.
Foster Engineering Co., Newark, N. J.
Grove Regulator Co., Oakland, Cal.
●Illinois Engineering Co., Chicago, Ill.
Keckley Co., O. C., Chicago, Ill.
Klipfel Mfg. Co., Chicago. Ill.
Leslie Co., Lyndhurst, N. J.
Mason-Neilan Regulator Co., Boston, Mass.
McAlear Mfg. Co., Chicago, Ill.
Milburn Co., Alexander, Baltimore, Md.
Mueller Co., Decatur, Ill.
Mueller Steam Specialty Co., Inc., New York, N. Y.
Norgren Co., Inc., C. A., Denver, Colo.
Penn Electric Switch Co., Goshen, Ind.
Ruggles-Klingemann Mfg. Co., Salem, Mass.
Schade Valve Mfg. Co., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Spray Engineering Co., Somerville, Mass.
Square D Co., Detroit, Mich.
Square D Co., Milwaukee, Wis.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice Co., H. O., Detroit, Mich.
Tryco Products, Inc., Westfield, Mass.
Watson & McDaniel Co., Philadelphia, Pa.
White-Rodgers Electric Co., St. Louis, Mo.

REGULATORS, PRESSURE, GAS

Askania Regulator Co., Chicago, Ill.
Atlas Valve Co., Inc., Newark, N. J.
Barber Gas Burner Co., Cleveland, O.
Belfield Co., H., Philadelphia, Pa.

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Boylston Steam Specialty Co., Chicago, Ill.
Bristol Co., Waterbury, Conn.
Brooke Engineering Co., Inc., Philadelphia, Pa.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Burdett Mfg. Co., Chicago, Ill.
●Cash Co., A. W., Decatur, Ill.
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
Cooper Co., Clark, Philadelphia, Pa.
Davis Regulator Co., Chicago, Ill.
Defender Automatic Regulator Co., St. Louis, Mo.
d'Este Co., Julian, Charlestown, Mass.
Dockson Co., C. H., Detroit, Mich.
Eclipse Fuel Engineering Co., Rockford, Ill.
Fisher Governor Co., Marshalltown, Ia.
Foster Engineering Co., Newark, N. J.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
General Controls Co., Glendale, Cal.
Grove Regulator Co., Oakland, Cal.
Harris Calorific Co., The, Cleveland, O.
●Illinois Engineering Co., Chicago, Ill.
Imperial Brass Mfg. Co., Chicago, Ill.
Kieley & Mueller, Inc., New York, N. Y.
Klipfel Mfg. Co., Chicago. Ill.
Leslie Co., Lyndhurst, N. J.
Mason-Neilan Regulator Co., Boston, Mass.
McAlear Mfg. Co., Chicago, Ill.
Milburn Co., Alexander, Baltimore, Md.
Monitor Controller Co., Baltimore, Md.
Mueller Co., Decatur, Ill.
Mueller Steam Specialty Co., Inc., New York, N. Y.
Norgren Co., Inc., C. A., Denver, Col.
Pacific Gas Radiator Co., Huntington Park, Cal.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
●Powers Regulator Co., Chicago, Ill.
Republic Flow Meters Co., Chicago, Ill. (Industrial)
Ruggles-Klingemann Mfg. Co., Salem, Mass.
Schade Valve Mfg. Co., Philadelphia, Pa.
Shallcross Controls, Inc., Milwaukee, Wis.
Sheer Co., H. M., Quincy, Ill.
Spence Engineering Co., Inc., Walden, N. Y.
Square D Co., Detroit, Mich.
Staples & Pfeiffer, Ltd., San Francisco, Cal.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice Co., H. O., Detroit, Mich.
Watson & McDaniel Co., Philadelphia, Pa.
White-Rodgers Electric Co., St. Louis, Mo.

REGULATORS, PRESSURE, HOT WATER HEATING SYSTEMS

Atlantic Valve & Pump Co., Chicago, Ill.
●Bell & Gossett Co., Chicago, Ill.
Fisher Governor Co., Marshalltown, Ia.
Hoffman Specialty Co., Inc., Waterbury, Conn.
Kainer Co., Chicago, Ill.
Kehm Corp., The, Chicago, Ill.
●Maid-O-Mist, Inc., Chicago, Ill.
Mueller Co., Decatur, Ill.
Penberthy Injector Co., Detroit, Mich.
Thrush & Co., H. A., Peru, Ind.
Watts Regulator Co., Lawrence, Mass.

REGULATORS, PRESSURE, LIQUID

Atlas Valve Co., Inc., Newark, N. J.
Belfield Co., H., Philadelphia, Pa.
Boylston Steam Specialty Co., Chicago, Ill.
Bristol Co., Waterbury, Conn.
Brooke Engineering Co., Inc., Philadelphia, Pa.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
●Cash Co., A. W., Decatur, Ill.
Cash Universal Regulator Co., Marshalltown, Ia.
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
Cooper Co., Clark, Philadelphia, Pa.
Davis Regulator Co., Chicago, Ill.
Defender Automatic Regulator Co., St. Louis, Mo.
d'Este Co., Julian, Charlestown, Mass.
Fisher Governor Co., Marshalltown, Ia.
Foster Engineering Co., Newark, N. J.
Foxboro Co., Foxboro, Mass.
●Fulton Sylphon Co., Knoxville, Tenn.
Golden-Anderson Valve Specialty Co., Pittsburgh, Pa.
Grove Regulator Co., Oakland, Cal.
Healy Ruff Co., St. Paul, Minn.
●Illinois Engineering Co., Chicago, Ill.
Justus Steam Trap Co., Napanoch, N. Y.
Keckley Co., O. C., Chicago, Ill.
Kieley & Mueller, Inc., New York, N. Y.
Klipfel Mfg. Co., Chicago, Ill.
Leslie Co., Lyndhurst, N. J.
Locke Regulator Co., Salem, Mass.
Marsh Corp., Jas. P., Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
McAlear Mfg. Co., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Monarch Mfg. Wks., Inc., Philadelphia, Pa.
Monitor Controller Co., Baltimore, Md.
Mueller Co., Decatur, Ill.
Mueller Steam Specialty Co., Inc., New York, N. Y.
Norgren Co., Inc., C. A. Denver, Colo.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
●Powers Regulator Co., Chicago, Ill.
Republic Flow Meters Co., Chicago, Ill.
Ruggles-Klingemann Mfg. Co., Salem, Mass.
Schade Valve Mfg. Co., Philadelphia, Pa.
Schutte & Koerting Co., Philadelphia, Pa.
Shallcross Controls, Inc., Milwaukee, Wis.
Spence Engineering Co., Inc., Walden, N. Y.
Square D Co., Detroit, Mich.
Square D Co., Milwaukee, Wis.
Staples & Pfeiffer, Ltd., San Francisco, Cal.
Stickle Steam Specialties Co., Indianapolis, Ind.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Swartwout Co., Cleveland, O.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice Co., H. O., Detroit, Mich.
Tryco Products, Inc., Westfield, Mass.
United Electric Controls Co., Boston, Mass.
Watson & McDaniel Co., Philadelphia, Pa.
Watts Regulator Co., Lawrence, Mass.

REGULATORS, PRESSURE, STEAM

●American District Steam Co., North Tonawanda, N. Y.
American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Atlas Valve Co., Inc., Newark, N. J.
Bailey Meter Co., Cleveland, O.
Belfield Co., H., Philadelphia, Pa.
Boylston Steam Specialty Co., Chicago, Ill.
Bristol Co., Waterbury, Conn
Brooke Engineering Co., Inc., Philadelphia, Pa.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Burrows Mfg. Co., F. A., York, Pa.
●Cash Co., A. W., Decatur, Ill.
Cash Universal Regulator Co., Marshalltown, Ia.
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
Cooper Co., Clark, Philadelphia, Pa.
Crane Co., Chicago, Ill.
Davis Regulator Co., Chicago, Ill.
Defender Automatic Regulator Co., St. Louis, Mo.
d'Este Co., Julian, Charlestown, Mass.
●Dunham Co., C. A., Chicago, Ill.
Eclipse Fuel Engineering Co., Rockford, Ill.
Engineer Co., New York, N. Y.
Fisher Governor Co., Marshalltown, Ia.
Foster Engineering Co., Newark, N. J.
Foxboro Co., Foxboro, Mass.
●Fulton Sylphon Co., Knoxville, Tenn.
Golden-Anderson Valve Specialty Co., Pittsburgh, Pa.
Gorton Heating Corp., Cranford, N. J.
Grove Regulator Co., Oakland, Cal.
Hagan Corp., Pittsburgh, Pa.
Hays Corp., Michigan City, Ind.
Hoffman Specialty Co., Inc., Waterbury, Conn.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
●Illinois Engineering Co., Chicago, Ill.
Keckley Co., O. C., Chicago, Ill.
Kieley & Mueller, Inc., New York, N. Y.
Kisco Boiler & Engineering Co., St. Louis, Mo.
Klipfel Mfg. Co., Chicago, Ill.
Leslie Co., Lyndhurst, N. J.
Locke Regulator Co., Salem, Mass.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., Bridgeport, Conn.
Marsh Corp., Jas. P., Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
McAlear Mfg. Co., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Monitor Controller Co., Baltimore, Md.
Mueller Co., Decatur, Ill.
Mueller Steam Specialty Co., Inc., New York, N. Y.
National Brass Co., Grand Rapids, Mich.
Norgren Co., Inc., C. A., Denver, Colo.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
●Powers Regulator Co., Chicago, Ill.
Republic Flow Meters Co., Chicago, Ill.
Ruggles-Klingemann Mfg. Co., Salem, Mass.
Schade Valve Mfg. Co., Philadelphia, Pa.
Shallcross Controls, Inc., Milwaukee, Wis.
Spence Engineering Co., Inc., Walden, N. Y.
Spencer Thermostat Co., Attleboro, Mass.
Squires Co., C. E., Cleveland, O.
Staples & Pfeiffer, Ltd., San Francisco, Cal.
Stickle Steam Specialties Co., Indianapolis, Ind.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Swartwout Co., Cleveland, O.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice Co., H. O., Detroit, Mich.
United Electric Controls Co., Boston, Mass.
Watson & McDaniel Co., Philadelphia, Pa.
Watts Regulator Co., Lawrence, Mass.
●Webster & Co., Warren, Camden, N. J.
White-Rodgers Electric Co., St. Louis, Mo.
Williams Gauge Co., Pittsburgh, Pa.

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REGULATORS, STATIC PRESSURE, AIR DUCT

Bristol Co., Waterbury, Conn.
●Johnson Service Co., Milwaukee, Wis.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
●Powers Regulator Co., Chicago, Ill.
White-Rodgers Electric Co., St. Louis, Mo.

REGULATORS, TEMPERATURE

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Atlas Valve Co., Inc., Newark, N. J.
●Au-Temp-Co Corp., New York, N. Y.
●Automatic Products Co., Milwaukee, Wis.
●Barber-Colman Co., Rockford, Ill.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Burling Instrument Co., Newark, N. J.
Cook Electric Co., Chicago, Ill.
Cooper Co., Clark, Philadelphia, Pa.
Defender Automatic Regulator Co., St. Louis, Mo.
d'Este Co., Julian, Charlestown, Mass.
●Detroit Lubricator Co., Detroit, Mich.
●Dunham Co., C. A., Chicago, Ill.
Eclipse Fuel Engineering Co., Rockford, Ill.
Edison, Inc., Thomas A., Edison Electrical Controls Div., West Orange, N. J.
Foster Engineering Co., Newark, N. J.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
●Fulton Sylphon Co., Knoxville, Tenn.
General Controls Co., Glendale, Cal.
H-B Instrument Co., Philadelphia, Pa.
Herske & Timmis, Inc., New York, N. Y.
●Illinois Engineering Co., Chicago, Ill.
●Johnson Service Co., Milwaukee, Wis.
Keckley Co., O. C., Chicago, Ill.
Klipfel Mfg. Co., Chicago, Ill.
Lawler Automatic Controls, Inc., Mount Vernon, N. Y.
Leeds & Northrup Co., Philadelphia, Pa.
Leslie Co., Lyndhurst, N. J.
Locke Regulator Co., Salem, Mass.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., Bridgeport, Conn.
Marsh Corp., Jas. P., Chicago, Ill.
Marsh Tritrol Co., Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
McCorkle Co., D. H., Berkeley, Cal.
Mercoid Corp., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Monitor Controller Co., Baltimore, Md.
Penn Electric Switch Co., Goshen, Ind.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
Pioneer Heat Regulator Div., Master Electric Co., The, Dayton, O.
●Powers Regulator Co., Chicago, Ill.
Precision Thermometer & Instrument Co., Philadelphia, Pa.
Pyrometer Instrument Co., New York, N. Y.
Ranco, Inc., Columbus, O.
Ruggles-Klingemann Mfg. Co., Salem, Mass.
●Sarco Co., Inc., New York, N. Y.
Spence Engineering Co., Inc., Walden, N. Y.
Spencer Thermostat Co., Attleboro, Mass.
Square D Co., Detroit, Mich.
Sterling Engineering Co., Milwaukee, Wis.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice Co., H. O., Detroit, Mich.
United Electric Controls Co., Boston, Mass.
Watson & McDaniel Co., Philadelphia, Pa.
Wheelco Instruments Co., Chicago, Ill.
White Mfg. Co., St. Paul, Minn.
White-Rodgers Electric Co., St. Louis, Mo.

RELAYS, ELECTRICAL

Advance Electric Co., Los Angeles, Cal.
●Allen-Bradley Co., Milwaukee, Wis.
Arrow-Hart & Hegeman Elect. Co., Hartford, Conn.
●Au-Temp-Co Corp., New York, N. Y.
Automatic Switch Co., New York, N. Y.
Automatic Temperature Control Co., Inc., Philadelphia, Pa.
●Bell & Gossett Co., Chicago, Ill.
Bender Warrick Corp., Birmingham, Mich.
Benjamin Electric Mfg. Co., Des Plaines, Ill.
Clark Controller Co., Cleveland, O.
Cutler-Hammer, Inc., Milwaukee, Wis.
●Detroit Lubricator Co., Detroit, Mich.
Dunn, Inc., Struthers, Philadelphia, Pa.
Edison, Inc., Thos. A., Edison Electrical Controls Div., West Orange, N. J.
Electric Controller & Mfg. Co., Cleveland, O.
Friez & Sons, Julien P., Baltimore, Md.
General Controls Co., Glendale, Cal.
General Electric Co., Schenectady, N. Y.
Gleason-Avery, Inc., Auburn, N. Y.
Guardian Electric Mfg. Co., Chicago, Ill.
H-B Instrument Co., Philadelphia, Pa.
Hart Mfg. Co., Hartford, Conn.
Herske & Timmis, Inc., New York, N. Y.
McCorkle Co., D. H., Berkeley, Calif.
Mercoid Corp., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Monitor Controller Co., Baltimore, Md.
Penn Electric Switch Co., Goshen, Ind.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
Precision Thermometer & Instrument Co., Philadelphia, Pa.
Russell Electric Co., Chicago, Ill.
Sheer Co., H. M., Quincy, Ill.
Spencer Thermostat Co., Attleboro, Mass.
Square D Co., Milwaukee, Wis.
Taylor Instrument Companies, Rochester, N. Y.
●Ward Leonard Electric Co., Mt. Vernon, N. Y.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Weston Electrical Instrument Corp., Newark, N. J.
White Mfg. Co., St. Paul, Minn.
White-Rodgers Electric Co., St. Louis, Mo.
Zenith Electric Co., Chicago, Ill.

RELIEF VALVES

See Valves, Relief

REPAIR CLAMPS

See Clamps, Pipe Repair

RESEATERS, VALVE

Leavitt Machine Co., Orange, Mass.
Standard Reseater Corp., New York, N. Y.

RINGS, PISTON, FOR COMPRESSORS

American Hammered Piston Ring Div., Koppers Co., Baltimore, Md.
●McQuay-Norris Mfg. Co., St. Louis, Mo.
Perfect Circle Co., The, Hagerstown, Ind.
Sealed Power Corp., Muskegon, Mich.

ROD, GAS WELDING

Air Reduction Sales Co., New York, N. Y.
American Agile Corp., Cleveland, O.
●American Brass Co., Waterbury, Conn.
American Steel & Wire Co., Cleveland, O.
Bridgeport Brass Co., Bridgeport, Conn.
●Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Crucible Steel Co. of America, New York, N. Y.
Duraloy Co., Scottdale, Pa. (Stainless)
Imperial Brass Mfg. Co., Chicago, Ill.
International Nickel Co., New York, N. Y.
Linde Air Products Co., The, Unit of Union Carbide & Carbon Corp., New York, N. Y.
Maurath, Inc., Cleveland, O.
Milburn Co., Alexander, Baltimore, Md.
Page Steel & Wire Division of American Chain & Cable Co., Inc., Monessen, Pa.
●Republic Steel Corp., Cleveland, O.
Revere Copper & Brass, Inc., New York, N. Y.
Roebling's Sons, John A., Trenton, N. J.
Seneca Wire & Mfg. Co., Fostoria, O.
Torchweld Equipment Co., Div. of National Cylinder Gas Co., Chicago, Ill.
Una Welding, Inc., E. Cleveland, O.
Universal Power Corp., Cleveland, O.
Walworth Co., New York, N. Y.
●Youngstown Sheet & Tube Co., Youngstown, O.

ROLLER BEARINGS

See Bearings, Roller

ROOF VENTILATORS

See Ventilators, Roof

ROOM HUMIDIFIERS

See Humidifiers, Unit, Room Type; and Units, Air Conditioning, Comfort, Winter

ROOM THERMOSTATS

See Thermostats, Room or Wall

ROTARY PUMPS

See Pumps, Rotary

RUBBER BELTING

See Belting, Flat, Rubber

RUBBER PACKING

See Packing, Rubber

RUBBER PIPE

See Pipe and Fittings, Hard Rubber

SCREENS, SOLAR HEAT RESISTING

Ingersoll Steel & Disc Co., Chicago, Ill.

SEAMLESS PIPE

See Pipe, Steel, Seamless

SEPARATORS, AIR

Adams Co., R. P., Buffalo, N. Y.
American Injector Co., Detroit, Mich.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Bubar, Hudson H., New York, N. Y.
Centrifix Corp., Cleveland, O.
Crane Co., Chicago, Ill.
DeVilbiss Co., The, Toledo, O.
Direct Separator Co., Inc., Syracuse, N. Y.
Hagan Corp., Pittsburgh, Pa.

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●Illinois Engineering Co., Chicago, Ill.
Johnson Corp., Three Rivers, Mich.
Keckley Co., O. C., Chicago, Ill.
Leavitt Machine Co., Orange, Mass.
Logan Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Milburn Co., Alexander, Baltimore, Md.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Spencer Turbine Co., Hartford, Conn.
Spray Engineering Co., Somerville, Mass.
●Staynew Filter Corp., Rochester, N. Y.
Straight Line Foundry & Machine Corp., Direct Separator Div., The, Syracuse, N. Y.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Swartwout Co., Cleveland, O.
Textite Corp., Chicago, Ill.
Trerice Co., H. O., Detroit, Mich.
Wright-Austin Co., Detroit, Mich.

SEPARATORS, STEAM AND OIL

Acme Industries, Inc., Jackson, Mich.
Adams Co., R. P., Buffalo, N. Y.
●American District Steam Co., North Tonawanda, N. Y.
Barrett Machine Co., N. S., Pittsburgh, Pa.
Boylston Steam Specialty Co., Chicago, Ill.
Centrifix Corp., Cleveland, O.
●Cochrane Corp., Philadelphia, Pa.
Crane Co., Chicago, Ill.
Croll-Reynolds Engineering Co., Inc., New York, N. Y.
Direct Separator Co., Inc., Syracuse, N. Y.
Elliott Co., Jeannette, Pa.
Fisher Governor Co., Marshalltown, Ia.
Hagan Corp., Pittsburgh, Pa.
●Illinois Engineering Co., Chicago, Ill.
Johnson Corp., Three Rivers, Mich.
Kieley & Mueller, Inc., New York, N. Y.
Kisco Boiler & Engineering Co., St. Louis, Mo.
Logan Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Morehead Mfg. Co., Detroit, Mich.
National Valve & Mfg. Co., Pittsburgh, Pa.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Richmond Engineering Co., Inc., Richmond, Va.
Schutte & Koerting Co., Philadelphia, Pa.
Stickle Steam Specialties Co., Indianapolis, Ind.
Straight Line Foundry & Machine Corp., Direct Separator Div., The, Syracuse, N. Y.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Swartwout Co., Cleveland, O.
Textite Corp., Chicago, Ill.
●Webster & Co., Warren, Camden, N. J.
Westfalia Separator Co., Bloomfield, N. J.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
Wright-Austin Co., Detroit, Mich.

SEWAGE EJECTORS

See Ejectors, Sewage

SHEARS, ELECTRIC, PORTABLE

Black & Decker Mfg. Co., Towson, Md.
G. D. S. Machinery & Supply Co., Inc., New York, N. Y.
Skilsaw, Inc., Chicago, Ill.
Stanley Works, New Britain, Conn.

SHEARS, POWER

Beatty Machine & Mfg. Co., Hammond, Ind.
Bertsch & Co., Inc., Cambridge City, Ind.
Bliss Co., E. W., Toledo, O.
●Buffalo Forge Co., Buffalo, N. Y.
Cincinnati Shaper Co., Cincinnati, O.
Cleveland Punch & Shear Works Co., Cleveland, O.
Excelsior Tool & Machine Co., East St. Louis, Ill.
Heartley Machine & Tool Co., Toledo, O.
Hendley & Whittemore, Beloit, Wis.
New Albany Machine Mfg. Co., New Albany, Ind.
Niagara Machine & Tool Wks., Buffalo, N. Y.
Peck, Stow & Wilcox Co., Southington, Conn.
Pels & Co., Inc., Henry, New York, N. Y.
Rafter Machine Co., Belleville, N. J.
Rock River Machine Co., Inc., Janesville, Wis.
Schatz Mfg. Co., Poughkeepsie, N. Y.
Yoder Co., The, Cleveland, O.

SHEARS AND SNIPS, HAND

Armstrong-Blum Mfg. Co., Chicago, Ill.
Bartlett Mfg. Co., Detroit, Mich.
Beverly Throatless Shear Co., Chicago, Ill.
Black & Decker Mfg. Co., Towson, Md.
Bremil Mfg. Co., Erie, Pa.
Clauss Shear Co., Fremont, O.
Crescent Tool Co., Jamestown, N. Y.
G. D. S. Machinery & Supply Co., Inc., New York, N. Y.
Grobet File Corp. of America, New York, N. Y.
Hendley & Whittemore, Beloit. Wis.
Kidder Mfg. Co., Inc., J. F., Burlington, Vt. (Angle)
Marshalltown Mfg. Co., Marshalltown, Ia.
Niagara Machine & Tool Wks., Buffalo, N. Y.
Peck, Stow & Wilcox Co., Southington, Conn.
Rafter Machine Co., Belleville, N. J.
Rupp Forge & Shear Co., Cleveland, O.
Stanley Wks., New Britain, Conn.
Viking Shear Co., Erie, Pa.
●Whitney Metal Tool Co., Rockford, Ill.
Wiss & Sons Co., J., Newark, N. J.

SHEET METAL BRAKES

See Brakes, Sheet Metal

SHEET METAL DUCTS

See Ducts and Duct Fittings, Prefabricated

SHEET METAL FITTINGS

See Ducts and Duct Fittings, Prefabricated

SHEET METAL PUNCHES

See Punches, Sheet Metal

SHEETS, ALUMINUM

Aluminum Co. of America, Pittsburgh, Pa.
American Nickeloid Co., Peru, Ill. (Nickel and chromium plated)
Fairmont Aluminum Co., Fairmont, W. Va.

SHEETS, CLAD

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Aluminum Co. of America, Pittsburgh, Pa.
●American Brass Co., Waterbury, Conn.
Ingersoll Steel & Disc Co., Chicago, Ill.
International Nickel Co., New York, N. Y.
Jessop Steel Co., Washington, Pa.
Lukens Steel Co., Coatesville, Pa.
Wheeling Metal & Mfg. Co., Wheeling, W. Va.

SHEETS, COPPER

●American Brass Co., Waterbury, Conn.
Bridgeport Brass Co., Bridgeport, Conn.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
●Hussey & Co., C. G., Pittsburgh, Pa.
National Brass & Copper Co., Inc., Lisbon, O.
New Haven Copper Co., Seymour, Conn.
Revere Copper & Brass, Inc., New York, N. Y.
United States Brass & Copper Co., Hyde Park, Boston, Mass.

SHEETS, LEAD

Alpha Metal & Rolling Mills, Inc., Brooklyn, N. Y.
Andrews Lead Co., Inc., Long Island City, N. Y.
Belmont Smelting & Refining Wks., Inc., Brooklyn, N. Y.
Eagle-Picher Lead Co., Cincinnati, O.
Flemm Lead Co., Inc., Long Island City, N. Y.
Lissberger & Son, Inc., Marks, Long Island City, N. Y.
National Lead Co., New York, N. Y.
Rochester Lead Wks., Rochester, N. Y.
Standard Rolling Mills, Inc., Brooklyn, N. Y.

SHEETS, STEEL, COPPER BEARING

●American Rolling Mill Co., The, Middletown, O.
Apollo Steel Co., Apollo, Pa.
Berger Mfg. Div., Republic Steel Corp., Canton, O.
Bethlehem Steel Co., Bethlehem, Pa.
●Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
●Columbia Steel Co. (Sub. United States Steel Corp.), San Francisco, Cal.
Continental Steel Corp., Kokomo, Ind.
Follansbee Bros. Co., Pittsburgh, Pa.
Granite City Steel Co., Granite City, Ill.
Inland Steel Co., Chicago, Ill.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Lukens Steel Co., Coatesville, Pa.
National Steel Corp., Pittsburgh, Pa.
Newport Rolling Mill Co., Div. of The Andrews Steel Co., Newport, Ky.
Otis Steel Co., Cleveland, O.
Reeves Steel & Mfg. Co., Dover, O.
●Republic Steel Corp., Cleveland, O.
Sharon Steel Corp., Sharon, Pa.
Superior Sheet Steel Co., The, Canton, O.
●Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.
Weirton Steel Co., Weirton, W. Va.
Wheeling Corrugating Co., Wheeling, W. Va.
Wheeling Steel Corp., Wheeling, W. Va.
●Youngstown Sheet & Tube, Co., Youngstown, O.

SHEETS, STEEL, GALVANIZED

●American Rolling Mill Co., The, Middletown, O.
Apollo Steel Co., Apollo, Pa.
Berger Mfg. Div., Republic Steel Corp., Canton, O.
Bethlehem Steel Co., Bethlehem, Pa.
●Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
●Columbia Steel Co. (Sub. United States Steel Corp.), San Francisco, Cal.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, New York, N. Y.
Empire Sheet & Tin Plate Co., Mansfield, O.
Granite City Steel Co., Granite City, Ill.
Inland Steel Co., Chicago, Ill.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Lukens Steel Co., Coatesville, Pa.
Lyon, Conklin & Co., Inc., Baltimore, Md.

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National Steel Corp., Pittsburgh, Pa.
Newport Rolling Mill Co., Div. of The Andrews Steel Co., Newport, Ky.
Niles Rolling Mill Co., Niles, O.
Otis Steel Co., Cleveland, O.
Parkersburg Iron & Steel Co., Parkersburg, W. Va.
Reeves Steel & Mfg. Co., Dover, O.
●Republic Steel Corp., Cleveland, O.
Sharon Steel Corp., Sharon, Pa.
Superior Sheet Steel Co., Tne, Canton, O.
●Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.
Weirton Steel Co., Weirton, W. Va.
Wheeling Steel Corp., Wheeling, W. Va.
●Youngstown Sheet & Tube Co., Youngstown, O.

SHEETS, STEEL, GALVANNEALED

Berger Mfg. Div., Republic Steel Corp., Canton, O.
●Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Continental Steel Corp., Kokomo, Ind.
Granite City Steel Co., Granite City, Ill.
Newport Rolling Mill Co., Div. of The Andrews Steel Co., Newport, Ky.
●Republic Steel Corp., Cleveland, O.
Sharon Steel Corp., Sharon, Pa.
Superior Sheet Steel Co., The, Div. of Continental Steel Corp., Canton, O.
●Youngstown Sheet & Tube Co., Youngstown, O.

SHEETS, STEEL, STAINLESS

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
●American Rolling Mill Co., The, Middletown, O.
Barium Stainless Steel Corp., Canton, O.
Berger Mfg. Div., Republic Steel Corp., Canton, O.
●Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Crucible Steel Co. of America, New York, N. Y.
Ingersoll Steel & Disc Co., Chicago, Ill.
International Nickel Co., New York, N. Y.
Jessop Steel Co., Washington, Pa.
Lukens Steel Co., Coatesville, Pa.
●Republic Steel Corp., Cleveland, O.
Ryerson & Son, Inc., Jos. T., Chicago, Ill.
Sharon Steel Corp., Sharon, Pa.
Universal-Cyclops Steel Corp., Bridgeville, Pa.

SHEETS, WROUGHT IRON

●Byers Co., A. M., Pittsburgh, Pa.

SHEETS, ZINC

American Nickeloid Co., Peru, Ill. (Nickel and chromium plated)
American Zinc Products Co., Greencastle, Ind.
Belmont Smelting & Refining Wks., Inc., Brooklyn, N. Y.
Hegeler Zinc Co., Danville, Ill.
Illinois Zinc Co., Chicago, Ill.
Matthiessen & Hegeler Zinc Co., La Salle, Ill.
New Jersey Zinc Sales Co., New York, N. Y.

SHUTTERS

See Louvers and Shutters

SLEEVE BEARINGS

See Bearings, Sleeve

SMOKE ALARMS

See Alarms, Smoke

SMOKE GUNS

See Guns and Pots, Smoke and Smudge

SMUDGE POTS

See Guns and Pots, Smoke and Smudge

SOCKET WRENCHES

See Wrenches, Socket

SOLAR HEAT RESISTING SCREENS

See Screens, Solar Heat Resisting

SOLDER, BRAZING ALLOYS, AND FLUXES

Air Reduction Sales Co., New York, N. Y.
Alpha Metal & Rolling Mills, Inc., Brooklyn, N. Y.
●American Brass Co., Waterbury, Conn.
American Solder & Flux Co., Philadelphia, Pa.
Belmont Smelting & Refining Wks., Inc., Brooklyn, N. Y.
Benson Co., Inc., Alex R., Hudson, N. Y.
Burnley Battery & Mfg. Co., North East, Pa.
Eagle-Picher Lead Co., Cincinnati, O.
Gardiner Metal Co., Chicago, Ill.
Handy & Harman, New York, N. Y. (Silver)
Imperial Brass Mfg. Co., Chicago, Ill.
Industrial Service Laboratories, Milwaukee, Wis.
Kester Solder Co., Chicago, Ill.
Linde Air Products Co., The, Unit of Union Carbide & Carbon Corp., New York, N. Y.
Lissberger & Son, Inc., Marks, Long Island City, N. Y.
National Lead Co., New York, N. Y.
Ruby Chemical Co., Columbus, O.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

SOLENOID VALVES

See Valves, Solenoid

SOOT BLOWERS

See Blowers, Soot

SOUND DEADENING FOR CEILING AND WALL

See Insulation, Ceiling and Wall, Sound Deadening

SOUND DEADENING FOR DUCTS

See Insulation, Duct, Sound Deadening

SOUND INDICATORS

See Indicators, Sound Level

SPEED CHANGERS

See Changers, Speed, Hydraulic Coupling; Changers, Speed, Mechanical

SPEED REDUCERS

See Reducers, Speed

SPIRAL PIPE

See Pipe, Spiral, Riveted and Welded

SPOT WELDERS

See Welders, Spot

SPRAY HUMIDIFIERS

See Humidifiers, Direct, Spray Head

SPRAY NOZZLES

See Nozzles, Spray

SPRINKLER HEADS

See Heads, Sprinkler

SPRINKLER SYSTEM CONTROLS

See Controls, Sprinkler System

STAINLESS STEEL PIPE

See Pipe, Steel, Stainless

STAINLESS STEEL SHEETS

See Sheets, Steel, Stainless

STANDS, PIPE VISE

American Pipe Tool Co., Chicago, Ill.
Armstrong Mfg. Co., Bridgeport, Conn.
Crown Die & Tool Co., Chicago, Ill.
Hollands Mfg. Co., Erie, Pa.
Martin & Sons, H. P., Owensboro, Ky.
Nye Tool & Machine Wks., The, Chicago, Ill.
Ridge Tool Co., Elyria, O.
Toledo Pipe Threading Machine Co., Toledo, O.
Western Wire Products Co., St. Louis, Mo.
●Williams & Co., J. H., New York, N. Y.

STEAM BOOSTER COMPRESSORS

See Compressors, Steam Booster

STEAM ENGINES

See Engines, Steam

STEAM JET REFRIGERATION

See Compressors, Refrigerating, Steam Jet

STEAM PRESSURE REGULATORS

See Regulators, Pressure, Steam

STEAM PUMPS

See Pumps, Steam

STEAM SEPARATORS

See Separators, Steam and Oil

STEAM TRAPS

See Traps, Steam

STEEL PIPE

See Pipe, Steel

STEEL TUBING

See Tubing, Steel

STEEL UNIONS

See Unions, Steel

STEEL VALVES

See Valves, Gate; and Valves, Globe

STERILIZING LAMPS

See Lamps, Sterilizing, for Duct Installation

STOCKS AND DIES

American Pipe Tool Co., Chicago, Ill.
Armstrong Bros. Tool Co., Chicago, Ill.
Armstrong Mfg. Co., Bridgeport, Conn.
Beaver Pipe Tools, Inc., Warren, O.
Champion Blower & Forge Co., Lancaster, Pa.
Crown Die & Tool Co., Chicago, Ill.
Erie Tool Wks., Erie, Pa.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hollands Mfg. Co., Erie, Pa.
Jarecki Mfg. Co., Erie, Pa.
Nye Tool & Machine Wks., The, Chicago, Ill.
Oster Mfg. Co., Cleveland, O.
Ridge Tool Co., Elyria, O.
Toledo Pipe Threading Machine Co., Toledo, O.
Walworth Co., New York, N. Y.

STOKERS, INDUSTRIAL AND COMMERCIAL

61 to 1200 Lb per Hr

American Coal Burner Co., Chicago, Ill.
American Engineering Co., Philadelphia, Pa.
Anchor Stove & Range Co., New Albany, Ind.
Auburn Foundry, Inc., Stoker Div., Auburn, Ind.
Automatic Stoker Corp., Milwaukee, Wis.

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Babcock & Wilcox Co., New York, N. Y.
Bluffton Mfg. Co., The, Findlay, O.
Bros Boiler & Mfg. Co., Wm., Minneapolis, Minn.
Brownell Co., Dayton, O.
Burke Stoker & Mfg. Co., Chicago, Ill.
Burnham Stoker Co., Vancouver, Wash.
Butler Mfg. Co., Kansas City, Mo.
Butler Street Foundry & Iron Co., Chicago, Ill.
Canton Stoker Corp., Canton, O.
Carnes, Inc., John R., Lima, O.
Clizbe Bros. Mfg. Co., Plymouth, Ind.
Columbus Metal Products, Inc., Columbus, O.
Crown Iron Works, Minneapolis, Minn.
Delta Stoker Co., North Chicago, Ill.
Detroit Stoker Co., Detroit, Mich.
Econocol Stoker Div. of Cotta Transmission Corp., Rockford, Ill.
Eddy Stoker Corp., Chicago, Ill.
Fairbanks, Morse & Co., Chicago, Ill.
Firemood Machine Wks., Converse, Ind.
Flynn & Emrich Co., Baltimore, Md.
Frederick Iron & Steel Co., Frederick, Md.
Fuel Savers, Inc., Harrisburg, Pa.
Gehl Bros. Mfg. Co., West Bend, Wis.
General Machinery Co., Spokane, Wash.
Grand Rapids Blow Pipe & Dust Arrester Co., Grand Rapids, Mich.
Heating Assurance, Inc., Spokane, Wash.
Her-Born Engrg. & Mfg. Co., Sandusky, O.
Hershey Machine & Foundry Co., Motorstoker Div., Manheim, Pa.
Hoffman Combustion Engineering Co., Detroit, Mich.
Holcomb & Hoke Mfg. Co., Indianapolis, Ind.
Illinois Iron & Bolt Co., Chicago, Ill.
International Engineering Wks., Inc., Framingham, Mass.
Iron Fireman Mfg. Co., Cleveland, O.
Johnston & Jennings Co., Cleveland, O.
Kol-Master Corp., Oregon, Ill.
Laclede Stoker Co., St. Louis, Mo.
Leffel & Co., Springfield, O.
"Loyal Knight" Stokers, Inc., Belleville, Ill.
Macrae, Inc., Brooklyn, N. Y.
Mallory Sales Co., Dolton, Ill.
Marion Machine Foundry & Supply Co., Marion, Ind.
McClave-Brooks Co., Scranton, Pa.
Muncie Gear Wks., Inc., Muncie, Ind.
National Steam Pump Co., Upper Sandusky, O.
Neemes Foundry, Inc., Troy, N. Y.
Orr & Sembower, Inc., Reading, Pa.
Patterson Foundry & Machine Co., East Liverpool, O.
Perfection Grate & Stoker Co., Springfield, Mass.
Riley Stoker Corp., Worcester, Mass.
Rosedale Foundry & Machine Co., Pittsburgh, Pa.
Schwitzer-Cummins Co, Indianapolis, Ind.
Sinker-Davis Co., Indianapolis, Ind.
Spencer Heater Div., Lycoming Mfg. Co., Williamsport, Pa.
Standard Stoker Corp., The, New Albany, N. Y.
Steel Products Engineering Co., Springfield, O.
Stok-A-Fire Co., University City, Mo.
Stokermatic Co., Salt Lake City, Utah.
Taylor Engineering Co., Cincinnati, O.
Whiting Corp., Harvey, Ill.
Will-Burt Co., The Orrville, O.

STONEWARE PIPE

See Pipe and Fittings, Stoneware

STORAGE WATER HEATERS

See Heaters, Water, Steam, Storage

STRAINERS, PIPE LINE

●American District Steam Co., North Tonawanda, N. Y.
American Injector Co., Detroit, Mich.
●Anderson Co., V. D., The, Cleveland, O.
●Automatic Products Co., Milwaukee, Wis.
Barrett, Haentjens & Co., Hazleton, Pa.
●Bishop & Babcock Mfg. Co., Cleveland, O.
Blackmer Pump Co., Grand Rapids, Mich.
Boylston Steam Specialty Co., Chicago, Ill.
Buffalo Meter Co., Buffalo, N. Y.
●Cash Co., A. W., Decatur, Ill.
Cash Universal Regulator Co., Marshalltown, Ia.
Cashin Co., W. D., Boston, Mass.
Central Brass Mfg. Co., Cleveland, O.
Crane Co., Chicago, Ill.
Cuno Engineering Corp., Meriden, Conn.
Davis Regulator Co., Chicago, Ill.
Direct Separator Co., Inc., Syracuse, N. Y.
Edward Valve & Mfg. Co., Inc., East Chicago, Ind.
Elliott Co., Jeannette, Pa.
Fisher Governor Co., Marshalltown, Ia.
Flagg & Co., Inc., Stanley G., Philadelphia, Pa.
Foster Engineering Co., Newark, N. J.
Foster Pump Works, Inc., Brooklyn, N. Y.
●Grinnell Co., Providence, R. I.
Hoffman Specialty Co., Inc., Waterbury, Conn.
●Illinois Engineering Co., Chicago, Ill.
Kaye & MacDonald, Inc., West Orange, N. J.
Keckley Co., O. C., Chicago, Ill.
Kieley & Mueller, New York, N. Y.
Kraissl Co., Inc., The, Hackensack, N. J.
Leslie Co., Lyndhurst, N. J.
●Maid-O-Mist, Inc., Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
McAlear Mfg. Co., Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Monarch Mfg. Wks., Inc., Philadelphia, Pa.
Mueller Co., Decatur, Ill.
Mueller Steam Specialty Co., New York, N. Y.
Newark Wire Cloth Co., Newark, N. J.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Rosedale Foundry & Machine Co., Pittsburgh, Pa.
●Sarco Co., New York, N. Y.
Schade Valve Mfg. Co., Philadelphia, Pa.
Schutte & Koerting Co., Philadelphia, Pa.
Sheffler-Gross Co., Philadelphia, Pa.
Spence Engineering Co., Walden, N. Y.
Spray Engineering Co., Somerville, Mass.
Staples & Pfeiffer, Ltd., San Francisco, Cal.
Sterling Engineering Co., Milwaukee, Wis.
Straight Line Foundry & Machine Corp., Direct Separator Div., The, Syracuse, N. Y.
●Streamline Pipe & Fittings Div., Mueller Brass Co., Port Huron, Mich.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Swartwout Co., Cleveland, O.
●Trane Co., La Crosse, Wis.
Trimount Rotary Power Co., East Dedham, Mass.
Tryco Products, Inc., Westfield, Mass.
Watson & McDaniel Co., Philadelphia, Pa.
Watts Regulator Co., Lawrence, Mass.
●Webster & Co., Warren, Camden, N. J.
Wright-Austin Co., Detroit, Mich.

STRESS RELIEVERS

See Preheaters and Stress Relievers, Electric, for Pipe Welds

STRIP HEATERS

See Heaters, Strip and Immersion, Electric

STRUCTURAL SHAPES

See Angles, Bars, Beams, Channels and Tees

SUMP PUMPS

See Pumps, Sump

SUPERHEATERS, PROCESS STEAM

Foster Wheeler Corp., New York, N. Y.
Johnston Bros., Inc., Ferrysburg, Mich.
●Marley Co., Kansas City, Kan.
Selas Co., The, Philadelphia, Pa.

SURFACE, COOLING, BRINE

Acme Industries, Inc., Jackson, Mich.
Advanced Refrigerating Systems Co., Philadelphia, Pa.
●Aerofin Corp., Syracuse, N. Y.
American Coils, Inc., Newark, N. J.
Beacon-Morris Corp., Boston, Mass.
Bohn Aluminum & Brass Corp., Detroit, Mich.
Bush Mfg. Co., Hartford, Conn.
Drayer & Hanson, Inc., Los Angeles, Cal.
●G. & O. Mfg. Co., New Haven, Conn.
General Refrigeration Corp., Beloit, Wis.
Griscom-Russell Co., The, New York, N. Y.
●Industrial Mfg. & Engineering Co., Chicago, Ill.
Kramer Trenton Co., Trenton, N. J.
Manufacturers Fin Coil Co., Chicago, Ill.
●Marlo Coil Co., St. Louis, Mo.
●McCord Radiator & Mfg. Co., Detroit, Mich.
●McQuay, Inc., Minneapolis, Minn.
Modine Mfg. Co., Racine, Wis.
Ohio Pipe Bending & Machine Co., Cleveland, O.
Peerless of America, Inc., Chicago, Ill.
Refrigeration Economics Co., Inc., Canton, O.
●Rempe Co., Chicago, Ill.
Roessing Mfg. Co., Pittsburgh, Pa.
Rome-Turney Radiator Co., Rome, N. Y.
Super Radiator Corp., Minneapolis, Minn.
●Trane Co., La Crosse, Wis.
●Unit Heater & Cooler Co., Wausau, Wis.
●Vilter Mfg. Co., Milwaukee, Wis.
●York Ice Machinery Corp., York, Pa.
●Young Radiator Co., Racine, Wis.

SURFACE, COOLING, COLD WATER

Acme Industries, Inc., Jackson, Mich.
Advanced Refrigerating Systems Co., Philadelphia, Pa.
●Aerofin Corp., Syracuse, N. Y.
American Coils, Inc., Newark, N. J.
Beacon-Morris Corp., Boston, Mass.
Bohn Aluminum & Brass Corp., Detroit, Mich.
Bush Mfg. Co., Hartford, Conn.
Drayer & Hanson, Inc., Los Angeles, Cal.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.
●G. & O. Mfg. Co., New Haven, Conn.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
General Refrigeration Corp., Beloit, Wis.
Griscom-Russell Co., The, New York, N. Y.
●Industrial Mfg. & Engineering Co., Chicago, Ill.
Johnson Fan & Blower Corp., Chicago, Ill.
Kennard, Inc., Sam, St. Louis, Mo.

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Kramer Trenton Co., Trenton, N. J.
Larkin Coils, Inc., Atlanta, Ga.
Manufacturers Fin Coil Co., Chicago, Ill.
●Marlo Coil Co., St. Louis, Mo.
●McCord Radiator & Mfg. Co., Detroit, Mich.
●McQuay, Inc., Minneapolis, Minn.
Modine Mfg. Co., Racine, Wis.
Mojonnier Bros. Co., Chicago, Ill.
●Nesbitt, Inc., John J., & Buckeye Blower Co., Philadelphia, Pa.
Peerless of America, Inc., Chicago, Ill.
Perfex Corp. (Unit Heater Div.), Milwaukee, Wis.
Refrigeration Appliances, Inc., Chicago, Ill.
Refrigeration Economics Co., Inc., Canton, O.
●Rempe Co., Chicago, Ill.
Roessing Mfg. Co., Pittsburgh, Pa.
Rome-Turney Radiator Co., Rome, N. Y.
Standard Galvanizing Co., Chicago, Ill.
Star Radiator Co., Los Angeles, Cal.
Super Radiator Corp., Minneapolis, Minn.
Tilco-Fin Inc., Brooklyn, N. Y.
●Trane Co., La Crosse, Wis.
●Unit Heater & Cooler Co., Wausau, Wis.
●Vilter Mfg. Co., Milwaukee, Wis.
●Wing Mfg. Co., L. J., New York, N. Y.
Yates-American Machine Co., Beloit, Wis.
●York Ice Machinery Corp., York, Pa.
●Young Radiator Co., Racine, Wis.

SURFACE, COOLING, DIRECT EXPANSION

Acme Industries, Inc., Jackson, Mich.
Advanced Refrigerating Systems Co., Philadelphia, Pa.
●Aerofin Corp., Syracuse, N. Y.
American Coils, Inc., Newark, N. J.
Beacon-Morris Corp., Boston, Mass.
Bohn Aluminum & Brass Corp., Detroit, Mich.
Bush Mfg. Co., Hartford, Conn.
Conditionaire Unit Co., Chicago, Ill.
Drayer & Hanson, Inc., Los Angeles, Cal.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.
●G. & O. Mfg. Co., New Haven, Conn.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
General Refrigeration Corp., Beloit, Wis.
Griscom-Russell Co., The, New York, N. Y.
Kennard, Inc., Sam, St. Louis, Mo.
Kramer Trenton Co., Trenton, N. J.
Larkin Coils, Inc., Atlanta, Ga.
Manufacturers Fin Coil Co., Chicago, Ill.
●Marlo Coil Co., St. Louis, Mo.
●McCord Radiator & Mfg. Co., Detroit, Mich.
●McQuay, Inc., Minneapolis, Minn.
Modine Mfg. Co., Racine, Wis.
Mojonnier Bros. Co., Chicago, Ill.
Ohio Pipe Bending & Machine Co., Cleveland, O.
Peerless of America, Inc., Chicago, Ill.
Refrigeration Appliances, Inc., Chicago, Ill.
Refrigeration Economics Co., Inc., Canton, O.
Reliance Refrigerating Machine Co., Chicago, Ill.
●Rempe Co., Chicago, Ill.
Roessing Mfg. Co., Pittsburgh, Pa.
Rome-Turney Radiator Co., Rome, N. Y.
Standard Galvanizing Co., Chicago, Ill.
Tilco-Fin Inc., Brooklyn, N. Y.
●Trane Co., La Crosse, Wis.
●Unit Heater & Cooler Co., Wausau, Wis.
●Vilter Mfg. Co., Milwaukee, Wis.
Yates-American Machine Co., Beloit, Wis.
●York Ice Machinery Corp., York, Pa.
●Young Radiator Co., Racine, Wis.

SURFACE, HEATING, INDIRECT, FERROUS

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Bayley Blower Co., Milwaukee, Wis.
●Burnham Boiler Co., Irvington, N. Y.
Griscom-Russell Co., The, New York, N. Y.
New York Blower Co., Chicago, Ill.
●Unit Heater & Cooler Co., Wausau, Wis.
Wolff & Munier, Inc., New York, N. Y. (For panel heating)

SURFACE, HEATING, INDIRECT, NON-FERROUS

●Aerofin Corp., Syracuse, N. Y.
American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Bayley Blower Co., Milwaukee, Wis.
Beacon-Morris Corp., Boston, Mass.
Bohn Aluminum & Brass Corp., Detroit, Mich.
Bush Mfg. Co., Hartford, Conn.
Drayer & Hanson, Inc., Los Angeles, Cal.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.
●G. & O. Mfg. Co., New Haven, Conn.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
Griscom-Russell Co., The, New York, N. Y.
●Industrial Mfg. & Engineering Co., Chicago, Ill.
Johnson Fan & Blower Corp., Chicago, Ill.
Kennard, Inc., Sam, St. Louis, Mo.
Kramer Trenton Co., Trenton, N. J.
●McCord Radiator & Mfg. Co., Detroit, Mich.
●McQuay, Inc., Minneapolis, Minn.
Modine Mfg. Co., Racine, Wis.
●Nesbitt, Inc., John J., & Buckeye Blower Co., Philadelphia, Pa.
Niagara Blower Co., New York, N. Y.
Peerless of America, Inc., Chicago, Ill.
Perfex Corp (Unit Heater Div.), Milwaukee, Wis.
●Rempe Co., Chicago, Ill.
Rome-Turney Radiator Co., Rome, N. Y.
Star Radiator Co., Los Angeles, Cal.
Super Radiator Corp., Minneapolis, Minn.
Tilco-Fin Inc., Brooklyn, N. Y.
●Trane Co., La Crosse, Wis.
●Unit Heater & Cooler Co., Wausau, Wis.
●Wing Mfg. Co., L. J., New York, N. Y.
Yates-American Machine Co., Beloit, Wis.
●York Ice Machinery Corp., York, Pa.
●Young Radiator Co., Racine, Wis.

SURFACE THERMOSTATS

See Thermostats, Surface

SWITCHES, ELECTRICAL

Adam Electric Co., Frank, St. Louis, Mo.
●Allen-Bradley Co., Milwaukee, Wis.
Arrow-Hart & Hegeman Elect. Co., Hartford, Conn.
Automatic Switch Co., New York, N. Y.
Clark Controller Co., Cleveland, O.
Cooper Co., Clark, Philadelphia, Pa.
Cutler-Hammer, Inc., Milwaukee, Wis.
Delta-Star Electric Co., Chicago, Ill.
Dunn, Inc., Struthers, Philadelphia, Pa.
Electric Controller & Mfg. Co., Cleveland, O.
General Controls Co., Glendale, Cal.
General Electric Co., Schenectady, N. Y.
Hart Mfg. Co., Hartford, Conn.
Marsh Corp., Jas. P., Chicago, Ill.
McDonnell & Miller, Chicago, Ill.
Mercoid Corp., Chicago, Ill.
Micro Switch Corp., Freeport, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Monitor Controller Co., Baltimore, Md.
Penn Electric Switch Co., Goshen, Ind.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
Square D Co., Detroit, Mich.
Square D Co., Milwaukee, Wis.
Tork Clock Co., Inc., Mount Vernon, N. Y.
Trumbull Electric Mfg. Co., Plainville, Conn.
●Ward Leonard Electric Co., Mount Vernon, N. Y.
Webster Electric Co., Racine, Wis.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
White Mfg. Co., St. Paul, Minn.
White-Rodgers Electric Co., St. Louis, Mo.

SWITCHES, FLOAT, REFRIGERATION

●Alco Valve Co., St. Louis, Mo.
Clark Controller Co., Cleveland, O.
McDonnell & Miller, Chicago, Ill.
Square D Co., Milwaukee, Wis.

SWITCHES, LIQUID LEVEL

●Allen-Bradley Co., Milwaukee, Wis.
Arrow-Hart & Hegeman Elect. Co., Hartford, Conn.
Bender Warrick Corp., Birmingham, Mich.
Bennett Co., Omaha, Neb.
Cissell Mfg. Co., W. M., Louisville, Ky.
Clark Controller Co., Cleveland, O.
Cooper Co., Clark, Philadelphia, Pa.
Cutler-Hammer, Inc., Milwaukee, Wis.
●Detroit Lubricator Co., Detroit, Mich.
General Electric Co., Schenectady, N. Y.
Hart Mfg. Co., Hartford, Conn.
Healy Ruff Co., St. Paul, Minn.
Kisco Boiler & Engineering Co., St. Louis, Mo.
McDonnell & Miller, Chicago, Ill.
Mercoid Corp., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Penn Electric Switch Co., Goshen, Ind.
Square D Co., Detroit, Mich.
Square D Co., Milwaukee, Wis.
Trumbull Electric Mfg. Co., Plainville, Conn.

SWITCHES, MERCURY

Automatic Temperature Control Co., Inc., Philadelphia, Pa.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Durakool, Inc., Elkhart, Ind.
Hart Mfg. Co., Hartford, Conn.
Jefferson Electric Co., Bellwood, Ill.
Mercoid Corp., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

SWITCHES, PRESSURE AND VACUUM

●Allen-Bradley Co., Milwaukee, Wis.
●Au-Temp-Co Corp., New York, N. Y.
Automatic Control Co., St. Paul, Minn.
Boston Auto Gage Co., Pittsfield, Mass.
Clark Controller Co., Cleveland, O.
Cooper Co., Clark, Philadelphia, Pa.
Cutler-Hammer, Inc., Milwaukee, Wis.
●Detroit Lubricator Co., Detroit, Mich.
Friez & Sons, Julien P., Baltimore, Md.
General Electric Co., Schenectady, N. Y.
Gleason-Avery, Inc., Auburn, N. Y.

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Marsh Corp., Jas. P., Chicago, Ill.
Mercoid Corp., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Monitor Controller Co., Baltimore, Md.
Penn Electric Switch Co., Goshen, Ind.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
Pioneer Heat Regulator Div., Master Electric Co., The, Dayton, O.
Spencer Thermostat Co., Attleboro, Mass.
Square D Co., Detroit, Mich.
Square D Co., Milwaukee, Wis.
Uniflow Mfg. Co., Erie, Pa.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
White-Rodgers Electric Co., St. Louis, Mo.

SWITCHES, TIME

●Au-Temp-Co Corp., New York, N. Y.
Automatic Temperature Control Co., Inc., Philadelphia, Pa.
Cramer Co., Inc., R. W., The, Centerbrook, Conn.
●Detroit Lubricator Co., Detroit, Mich.
Edison, Inc., Thomas A., Edison Electrical Controls Div., West Orange, N. J.
General Controls Co., Glendale, Cal.
General Electric Co., Schenectady, N. Y.
Gleason-Avery, Inc., Auburn, N. Y.
Guardian Electric Mfg. Co., Chicago, Ill.
Industrial Engineering Corp., Evansville, Ind.
Mercoid Corp., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Paragon Electric Co., Chicago, Ill.
Penn Electric Switch Co., Goshen, Ind.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
Reliance Automatic Lighting Co., Racine, Wis.
Rhodes, Inc., M. H., Hartford, Conn.
Sampsel Time Control, Inc., Mendota, Ill.
Sangamo Electric Co., Springfield, Ill.
Spencer Thermostat Co., Attleboro, Mass.
Tork Clock Co., Inc., Mount Vernon, N. Y.
●Ward Leonard Electric Co., Mt. Vernon, N. Y.

SYSTEMS, COMBUSTION CONTROL

Askania Regulator Co., Chicago, Ill.
Bailey Meter Co., Cleveland, O.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Bristol Co., Waterbury, Conn.
Brooke Engineering Co., Inc., Philadelphia, Pa.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
●Cash Co., A. W., Decatur, Ill.
Engineer Co., New York, N. Y.
Foster Wheeler Corp., New York, N. Y.
Hagan Corp., Pittsburgh, Pa.
Hays Corp., Michigan City, Ind.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
●Illinois Engineering Co., Chicago, Ill.
Leeds & Northrup Co., Philadelphia, Pa.
Mason-Neilan Regulator Co., Boston, Mass.
Mercoid Corp., Chicago, Ill.
National Brass Co., Grand Rapids, Mich.
Republic Flow Meters Co., Chicago, Ill.
Ruggles-Klingemann Mfg. Co., Salem, Mass.
Shallcross Controls, Inc., Milwaukee, Wis.
Wheelco Instrument Co., Chicago, Ill.

SYSTEMS, HEATING, HOT WATER

Atlantic Valve & Pump Co., Chicago, Ill.
●Bell & Gossett Co., Chicago, Ill.
General Blower Co., Inc., Philadelphia, Pa.
General Fittings Co., Providence, R. I.
Hoffman Specialty Co., Inc., Waterbury, Conn.
Kainer & Co., Chicago, Ill.
Kehm Corp., The, Chicago, Ill.
Lawler Automatic Controls, Inc., Mount Vernon, N. Y.
●Maid-O-Mist, Inc., Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Penberthy Injector Co., Detroit, Mich.
Thrush & Co., H. A., Peru, Ind.
Triplex Mfg. Co., Peru, Ind.
Watts Regulator Co., Lawrence, Mass.

SYSTEMS, HEATING, VACUUM

Barnes & Jones, Inc., Jamaica Plain, Boston, Mass.
Cashin, W. D., Boston, Mass.
●Dunham Co., C. A., Chicago, Ill.
Gorton Heating Corp., Cranford, N. J.
Hoffman Specialty Co., Inc., Waterbury, Conn.
●Illinois Engineering Co., Chicago, Ill.
Marsh Corp., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Monash-Younker Co., Chicago, Ill.
Mouat Vapor Heating Co., The, Cleveland, O.
●Sarco Co., Inc., New York, N. Y.
Sterling Engineering Co., Milwaukee, Wis.
Stickle Steam Specialties Co., Indianapolis, Ind.
●Webster & Co., Warren, Camden, N. J.

SYSTEMS, HEATING, VAPOR

●American District Steam Co., North Tonawanda, N. Y.
Barnes & Jones, Inc., Boston, Mass.
●Dunham Co., C. A., Chicago, Ill.
Gorton Heating Corp., Cranford, N. J.
Hoffman Specialty Co., Inc., Waterbury, Conn.
●Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Monash-Younker Co., Chicago, Ill.
Mouat Vapor Heating Co., The, Cleveland, O.
Sterling Engineering Co., Milwaukee, Wis.
Vapor Specialty Co., New York, N. Y.
●Webster & Co., Warren, Camden, N. J.

SYSTEMS, HEATING, ZONE CONTROL

●Au-Temp-Co Corp., New York, N. Y.
Automatic Temperature Control Co., Inc., Philadelphia, Pa.
●Barber-Colman Co., Rockford, Ill.
Barnes & Jones, Inc., Boston, Mass.
●Dunham Co., C. A., Chicago, Ill.
Foxboro Co., Foxboro, Mass.
●Illinois Engineering Co., Chicago, Ill.
●Johnson Service Co., Milwaukee, Wis.
Marsh Tritrol Co., Chicago, Ill.
Mercoid Corp., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Raymond Co., F. I., Chicago, Ill.
●Sarco Co., Inc., New York, N. Y.
Spence Engineering Co., Inc., Walden, N. Y.
Tallmadge & Co., Webster, East Orange, N. J.
Thrush & Co., H. A., Peru, Ind.
●Webster & Co., Warren, Camden, N. J.

SYSTEMS, PROCESS HEATING, HIGH TEMPERATURE

Automatic Temperature Control Co., Inc., Philadelphia, Pa.
Dow Chemical Co., Midland, Mich.
Foster Wheeler Corp., New York, N. Y.
Parks-Cramer Co., Fitchburg, Mass.
Ross Engineering Corp., J. O., New York, N. Y.

SYSTEMS, SPRINKLER, FOR AIR CONDITIONING DUCT SYSTEMS

Rockwood Sprinkler Co., Worcester, Mass.

TANKS, PROCESS AND STORAGE

American Locomotive Co., Alco Products Div., New York, N. Y.
Ames Iron Works, Div. of Pierce Butler Radiator Corp., Oswego, N. Y.
Bigelow Co., New Haven, Conn.
Biggs Boiler Wks. Co., E. Akron, O.
Bros Boiler & Mfg. Co., Wm., Minneapolis, Minn.
Brownell Co., Dayton, O.
Buffalo Tank Co., Arlington, Staten Island, N. Y.
Caldwell Co., W. E., Louisville, Ky.
Case & Son Mfg. Co., W. A., Buffalo, N. Y.
Chicago Bridge & Iron Co., Chicago, Ill.
Columbian Steel Tank Co., Kansas City, Mo.
Connery Construction Co., Philadelphia, Pa.
Continental Diamond Fibre Co., Newark, Del.
Dahlquist Mfg. Co., Inc., Boston, Mass.
Devine Mfg. Co., Inc., J. P., Mt. Vernon, Ill.
Dillon Steam Boiler Wks., Inc., D. M., Fitchburg, Mass.
Downingtown Iron Wks., Downingtown, Pa.
Eclipse Fuel Engineering Co., Rockford, Ill.
Falstrom Co., Passaic, N. J.
Farquhar Co., Ltd., A. B., York, Pa.
Farrar & Trefts, Buffalo, N. Y.
Gerstein & Cooper Co., South Boston, Mass.
Goodrich Co., B. F., Akron, O.
Grand Rapids Blow Pipe & Dust Arrester Co., Grand Rapids, Mich.
Graver Tank & Mfg. Co., Inc., East Chicago, Ind.
Hamburg Boiler Wks., Inc., Hamburg, Pa.
Harris & Co., Arthur, Chicago, Ill.
International Boiler Wks. Co., East Stroudsburg, Pa.
International Engineering Wks., Framingham, Mass.
●Kewanee Boiler Corp., Kewanee, Ill.
Kirk & Blum Mfg. Co., Cincinnati, O.
Kisco Boiler & Engineering Co., St. Louis, Mo.
Koven & Bro., Inc., L. O., Jersey City, N. J.
La Crosse Tractor Co., La Crosse, Wis.
Lead Lined Iron Pipe Co., Wakefield, Mass.
Littleford Bros., Cincinnati, O.
Manitowoc Boiler Wks., Manitowoc, Wis.
Mauck Seamless Copper Tank Co., Victor, Norristown, Pa.
Maxweld Corp., Brooklyn, N. Y.
Milwaukee Reliance Boiler Wks., Milwaukee, Wis.
Murray Iron Wks. Co., Burlington, Ia.
●Patterson-Kelley Co., Inc., East Stroudsburg, Pa.
Quaker City Iron Wks., Philadelphia, Pa.
Richmond Engineering Co., Inc., Richmond, Va.
Roessing Mfg. Co., Pittsburgh, Pa.
Scaife & Sons Co., Wm. B., Oakmont, Pa.
Strandwitz & Co., Inc., W. J., Camden, N. J.
Tippett & Wood, Phillipsburg, N. J.
Titusville Iron Wks. Co., Titusville, Pa.
Trageser Steam Copper Wks., John, Maspeth, Long Island, N. Y.
Uniflow Mfg. Co., Erie, Pa.
United States Rubber Co., New York, N. Y.
Walsh-Holyoke Steam Boiler Co., Holyoke, Mass.
Wheeling Steel Corp., Wheeling, W. Va. (Heater)

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Whitehead Metal Products Co. of New York, Inc., New York, N. Y.
Whitlock Coil Pipe Co., Hartford, Conn.

TEMPERATURE AND HUMIDITY CONTROLS

See Humidistats; Recorder-Controllers; Thermostats

TEMPERATURE RECORDERS

See Recorders, Temperature

TEMPERATURE REGULATORS

See Regulators, Temperature

THERMOMETERS, INDICATING, INDUSTRIAL

American Thermometer Co., St. Louis, Mo.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Crew-Equipment Co., Inc., New York, N. Y.
Electric Auto-Lite Co., Moto Meter Gauge & Equipment Div., La Crosse, Wis.
Foxboro Co., Foxboro, Mass.
G. M. Mfg. Co., New York, N. Y.
H-B Instrument Co., Philadelphia, Pa.
Hays Corp., Michigan City, Ind.
Hill, E. Vernon, Chicago, Ill.
Ideal Commutator Dresser Co., Sycamore, Ill.
●Illinois Testing Laboratories, Inc., Chicago, Ill.
●Johnson Service Co., Milwaukee, Wis.
Leeds & Northrup Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., Bridgeport, Conn.
Marsh Corp., Jas. P., Chicago, Ill.
Martocello & Co., Jos. A., Philadelphia, Pa.
Mason-Neilan Regulator Co., Boston, Mass.
Moeller Instrument Co., Richmond Hill, N. Y.
Palmer Co., Cincinnati (Norwood), O.
Philadelphia Thermometer Co., Philadelphia, Pa.
Pierce, Butler Radiator Corp., Syracuse, N. Y.
●Powers Regulator Co., Chicago, Ill.
Precision Thermometer & Instrument Co., Philadelphia, Pa.
Pyrometer Instrument Co., New York, N. Y.
Rochester Mfg. Co., Rochester, N. Y.
Scientific Instrument Co., Detroit, Mich.
Standard Thermometer, Inc., Boston, Mass.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Trerice Co., H. O., Detroit, Mich.
United States Gauge Co., New York, N. Y.
Weston Electrical Instrument Corp., Newark, N. J.
Wheelco Instruments Co., Chicago, Ill.

THERMOMETERS, INDICATING, REMOTE-READING

Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Electric Auto-Lite Co., Moto Meter Gauge & Equipment Div., La Crosse, Wis.
Engelhard, Inc., Charles, Newark, N. J.
Fee & Stemwedel, Inc., Chicago, Ill.
Foxboro Co., Foxboro, Mass.
H-B Instrument Co., Philadelphia, Pa.
Hays Corp., Michigan City, Ind.
●Illinois Testing Laboratories, Inc., Chicago, Ill.
●Johnson Service Co., Milwaukee, Wis.
Leeds & Northrup Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., Bridgeport, Conn.
Marsh Corp., Jas. P., Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
Moeller Instrument Co., Richmond Hill, N. Y.
Palmer Co., Cincinnati (Norwood), O.
●Powers Regulator Co., Chicago, Ill.
Pyrometer Instrument Co., New York, N. Y.
Rochester Mfg. Co., Rochester, N. Y.
●Sarco Co., Inc., New York, N. Y.
Scientific Instrument Co., Detroit, Mich.
Standard Thermometer, Inc., Boston, Mass.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Thwing-Albert Instrument Co., Philadelphia, Pa.
Trerice Co., H. O., Detroit, Mich.
United States Gauge Co., New York, N. Y.
Wheelco Instruments Co., Chicago, Ill.

THERMOMETERS, INDICATING, WALL

American Thermometer Co., St. Louis, Mo.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Electric Auto-Lite Co., Moto Meter Gauge & Equipment Div., La Crosse, Wis.
Engelhard Inc., Charles, Newark, N. J.
Fee and Stemwedel, Inc., Chicago, Ill.
Foxboro Co., Foxboro, Mass.
G. M. Mfg. Co., New York, N. Y.
H-B Instrument Co., Philadelphia, Pa.
Hill, E. Vernon, Chicago, Ill.
●Illinois Testing Laboratories, Inc., Chicago, Ill.
Leeds & Northrup Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., Bridgeport, Conn.
Marsh Corp., Jas. P., Chicago, Ill.
Martocello & Co., Jos. A., Philadelphia, Pa.
Moeller Instrument Co., Richmond Hill, N. Y.
Palmer Co., Cincinnati (Norwood), O.
Parsons, John R., New York, N. Y. (Effective temperature indicator)
Philadelphia Thermometer Co., Philadelphia, Pa.
Precision Thermometer & Instrument Co., Philadelphia, Pa.
Rochester Mfg. Co., Rochester, N. Y.
Scientific Instrument Co., Detroit, Mich.
Standard Thermometer, Inc., Boston, Mass.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Thwing-Albert Instrument Co., Philadelphia, Pa.
Trerice Co., H. O., Detroit, Mich.
United States Gauge Co., New York, N. Y.
Weston Electrical Instrument Corp., Newark, N. J.
Wheelco Instruments Co., Chicago, Ill.

THERMOMETERS, KATA

G. M. Mfg. Co., New York, N. Y.
Palmer Co., Cincinnati (Norwood), O.
Precision Thermometer & Instrument Co., Philadelphia, Pa.

THERMOSTATIC BELLOWS

See Bellows, Thermostatic

THERMOSTATIC BI-METALS

See Bi-Metals, Thermostatic

THERMOSTATIC TRAPS

See Traps, Steam, Thermostatic

THERMOSTATS, DUCT TYPE

●Au-Temp-Co Corp., New York, N. Y.
●Barber-Colman Co., Rockford, Ill.
Bristol Co., Waterbury, Conn.
Burling Instrument Co., Newark, N. J.
Cook Electric Co., Chicago, Ill.
D & M Mfg. Co., Midland Park, N. J.
●Detroit Lubricator Co., Detroit, Mich.
Edison, Inc., Thomas A., Edison Electric Controls Div., West Orange, N. J.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
Hart Mfg. Co., Hartford, Conn.
Jefferson Electric Co., Bellwood, Ill.
●Johnson Service Co., Milwaukee, Wis.
Leslie Co., Lyndhurst, N. J.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Penn Electric Switch Co., Goshen, Ind.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
Philadelphia Thermometer Co., Philadelphia, Pa.
●Powers Regulator Co., Chicago, Ill.
●Sarco Co., New York, N. Y.
Sheer Co., H. M., Quincy, Ill.
Spencer Thermostat Co., Attleboro, Mass.
Standard Thermometer, Inc., Boston, Mass.
Superstat Co., Springfield, Mass.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Tallmadge & Co., Webster, East Orange, N. J.
Taylor Instrument Companies, Rochester, N. Y.
United Electric Controls Co., Boston, Mass.
Vapor Car Heating Co., Inc., Chicago, Ill.
White-Rodgers Electric Co., St. Louis, Mo.

THERMOSTATS, EFFECTIVE TEMPERATURE

●Barber-Colman Co., Rockford, Ill.
D & M Mfg. Co., Midland Park, N. J.
●Johnson Service Co., Milwaukee, Wis.
Friez & Sons, Julien P., Baltimore, Md.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
●Powers Regulator Co., Chicago, Ill.
Taylor Instrument Companies, Rochester, N. Y.

THERMOSTATS, IMMERSION

●Au-Temp-Co Corp., New York, N. Y.
●Barber-Colman Co., Rockford, Ill.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Burling Instrument Co., Newark, N. J.
D & M Mfg. Co., Midland Park, N. J.
d'Este Co., Julian, Charlestown, Mass.
●Detroit Lubricator Co., Detroit, Mich.
Dunn, Inc., Struthers, Philadelphia, Pa.
Edison, Inc., Thomas A., Edison Electric Controls Div., West Orange, N. J.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
H-B Instrument Co., Philadelphia, Pa.
Hart Mfg. Co., Hartford, Conn.
Jefferson Electric Co., Bellwood, Ill.
●Johnson Service Co., Milwaukee, Wis.
Leslie Co., Lyndhurst, N. J.
Mercoid Corp., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Penn Electric Switch Co., Goshen, Ind.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
Pioneer Heat Regulator Div., Master Electric Co., The, Dayton, O.
●Powers Regulator Co., Chicago, Ill.
Precision Thermometer & Instrument Co., Philadelphia, Pa.

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●Sarco Co., Inc., New York, N. Y.
Spencer Thermostat Co., Attleboro, Mass.
Superstat Co., Springfield, Mass.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Thwing-Albert Instrument Co., Philadelphia, Pa.
United Electric Controls Co., Boston, Mass.
Warren Electric Appliance Co., Warren, Pa.
White-Rodgers Electric Co., St. Louis, Mo.
Wilcolator Co., Newark, N. J.

THERMOSTATS, ROOM OR WALL

Atlantic Valve & Pump Co., Chicago, Ill.
●Au-Temp-Co Corp., New York, N. Y.
●Automatic Products Co., Milwaukee, Wis.
●Barber-Colman Co., Rockford, Ill.
●Bell & Gossett Co., Chicago, Ill.
Bristol Co., Waterbury, Conn.
Cook Electric Co., Chicago, Ill.
Crise Elec. Mfg. Co., Mt. Vernon, O.
●Detroit Lubricator Co., Detroit, Mich.
Friez & Sons, Julien P., Baltimore, Md.
●Fulton Sylphon Co., Knoxville, Tenn.
General Controls Co., Glendale, Cal.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
Gleason-Avery, Inc., Auburn, N. Y.
●Illinois Engineering Co., Chicago, Ill.
Jefferson Electric Co., Bellwood, Ill.
●Johnson Service Co., Milwaukee, Wis.
●Magnet Switch Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
McCorkle Co., D. H., Berkeley, Calif.
Mercoid Corp., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Penn Electric Switch Co., Goshen, Ind.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
Pioneer Heat Regulator Div., Master Electric Co., The, Dayton, O.
●Powers Regulator Co., Chicago, Ill.
Russell Electric Co., Chicago, Ill.
●Sarco Co., Inc., New York, N. Y.
Sheer Co., H. M., Quincy, Ill.
Spencer Thermostat Co., Attleboro, Mass.
Standard Thermometer, Inc., Boston, Mass.
Superstat Co., Springfield, Mass.
Tallmadge & Co., Webster, East Orange, N. J.
Taylor Instrument Companies, Rochester, N. Y.
Thrush & Co., H. A., Peru, Ind.
United Electric Controls Co., Boston, Mass.
Vapor Car Heating Co., Inc., Chicago, Ill.
White Mfg. Co., St. Paul, Minn.
White-Rodgers Electric Co., St. Louis, Mo.

THERMOSTATS, SURFACE

●Au-Temp-Co Corp., New York, N. Y.
●Barber-Colman Co., Rockford, Ill.
Bristol Co., Waterbury, Conn.
●Detroit Lubricator Co., Detroit, Mich.
Dunn, Inc., Struthers, Philadelphia, Pa.
Edison, Inc., Thomas A., Edison Electric Controls Div., West Orange, N. J.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
Hart Mfg. Co., Hartford, Conn.
Jefferson Electric Co., Bellwood, Ill.
McCorkle Co., D. H., Berkeley, Cal.
Mercoid Corp., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Penn Electric Switch Co., Goshen, Ind.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
Pioneer Heat Regulator Div., Master Electric Co., The Dayton, Ohio.
●Powers Regulator Co., Chicago, Ill.
Ranco, Inc., Columbus, O.
●Sarco Co., Inc., New York, N. Y.
Sheer Co., H. M., Quincy, Ill.
Spencer Thermostat Co., Attleboro, Mass.
Superstat Co., Springfield, Mass.
Taylor Instrument Companies, Rochester, N. Y.
United Electric Controls Co., Boston, Mass.
White-Rodgers Electric Co., St. Louis, Mo.

THERMOSTATS, TWO TEMPERATURE OR DUAL

●Au-Temp-Co Corp., New York, N. Y.
●Barber-Colman Co., Rockford, Ill.
Burling Instrument Co., Newark, N. J.
●Detroit Lubricator Co., Detroit, Mich.
Friez & Sons, Julien P., Baltimore, Md.
General Controls Co., Glendale, Cal.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
Gleason-Avery, Inc., Auburn, N. Y.
H-B Instrument Co., Philadelphia, Pa.
Herske & Timmis, Inc., New York, N. Y.
●Illinois Engineering Co., Chicago, Ill.
Jefferson Electric Co., Bellwood, Ill.
●Johnson Service Co., Milwaukee, Wis.
McAlear Mfg. Co., Chicago, Ill.
Mercoid Corp., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Penn Electric Switch Co., Goshen, Ind.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
Pioneer Heat Regulator Div., Master Electric Co., The, Dayton, O.
●Powers Regulator Co., Chicago, Ill.
Ranco, Inc., Columbus, O.
●Sarco Co., Inc., New York, N. Y.
Sheer Co., H. M., Quincy, Ill.
Superstat Co., Springfield, Mass.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
United Electric Controls Co., Boston, Mass.
Vapor Car Heating Co., Inc., Chicago, Ill.
White-Rodgers Electric Co., St. Louis, Mo.

THERMOSTATS, WEATHER COMPENSATING

●Au-Temp-Co Corp., New York, N. Y.
●Barber-Colman Co., Rockford, Ill.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
●Detroit Lubricator Co., Detroit, Mich.
Foxboro Co., Foxboro, Mass.
Herske & Timmis, Inc., New York, N. Y.
●Illinois Engineering Co., Chicago, Ill.
●Johnson Service Co., Milwaukee, Wis.
Lawler Automatic Controls, Inc., Mount Vernon, N. Y.
Leeds & Northrup Co., Philadelphia, Pa.
Marsh Tritrol Co., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
●Powers Regulator Co., Chicago, Ill.
●Sarco Co., Inc., New York, N. Y.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Thrush & Co., H. A., Peru, Ind.
United Electric Controls Co., Boston, Mass.

TIME SWITCHES

See Switches, Time

TOGGLE BOLTS

See Bolts, Toggle and Anchor

TONGS, PIPE

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Jarecki Mfg. Co., Erie, Pa.
Trimont Mfg. Co., Boston, Mass.
●Williams & Co., J. H., New York, N. Y.

TORCHES, BRAZING

Air Reduction Sales Co., New York, N. Y.
Bastian-Blessing Co., Chicago, Ill.
Bernz Co., Inc., Otto, Rochester, N. Y.
Burdett Mfg. Co., Chicago, Ill.
Clayton & Lambert Mfg. Co., Detroit, Mich.
Dockson Co., C. H., Detroit, Mich.
Gasweld Equipment Co., Chicago, Ill.
Harris Calorific Co., The, Cleveland, O.
Imperial Brass Mfg. Co., Chicago, Ill.
Johnson Gas Appliance Co., Cedar Rapids, Ia.
Linde Air Products Co., The, Unit of Union Carbide & Carbon Corp., New York, N. Y.
Milburn Co., Alexander, Baltimore, Md.
Modern Engineering Co., St. Louis, Mo.
Sight Feed Generator Co., Richmond, Ind.
Smith Welding Equipment Co., Minneapolis, Minn.
Torchweld Equipment Co., Div. of National Cylinder Gas Co., Chicago, Ill.
Welding Apparatus Co., Chicago, Ill.

TORQUE INDICATING WRENCHES

See Wrenches, Torque Indicating

TOWERS, COOLING, ATMOSPHERIC

American Cooling Tower Co., Kansas City, Mo.
Binks Mfg. Co., Chicago, Ill.
Burhorn Co., Edwin, Hoboken, N. J.
Cooling Tower Co., Inc., The, Div. of The Fluor Corp., Ltd., New York, N. Y.
Fluor Corp., Ltd., The, Los Angeles, Cal.
Foster Wheeler Corp., New York, N. Y.
Lilie-Hoffmann Cooling Towers, Inc., St. Louis, Mo.
●Marley Co., Kansas City, Mo.
Penn Cooling Tower Wks., Pittsburgh, Pa.
Pennsylvania Engineering Wks., New Castle, Pa.
Schubert-Christy Corp., Affton, St. Louis, Mo.
Star Radiator Co., Los Angeles, Cal.
Stewart Ice Machine Co., Los Angeles, Cal.
Tippett & Wood, Phillipsburg, N. J.
Water Cooling Tower Co., Chicago, Ill.
Wheeler Mfg. Co., C. H., Philadelphia, Pa.

TOWERS, COOLING, MECHANICAL DRAFT

Binks Mfg. Co., Chicago, Ill.
Burhorn Co., Edwin, Hoboken, N. J.
Cooling Tower Co., Inc., The, Div. of The Fluor Corp., Ltd., New York, N. Y.
Fluor Corp., Ltd., The, Los Angeles, Cal.
Foster Wheeler Corp., New York, N. Y.
●Hess Warming & Ventilating Co., Chicago, Ill.
Lilie-Hoffmann Cooling Towers, Inc., St. Louis, Mo.
●Marley Co., Kansas City, Mo.
Motor Equipment Co., Wichita, Kan.
Penn Cooling Tower Wks., Pittsburgh, Pa.

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Pennsylvania Engineering Wks., New Castle, Pa.
Propellair, Inc., Springfield, O.
Research Corp., New York, N. Y.
Schubert-Christy Corp., Affton, St. Louis, Mo.
Star Radiator Co., Los Angeles, Cal.
Water Cooling Tower Co., Chicago, Ill.
Wheeler Mfg. Co., C. H., Philadelphia, Pa.

TRANSMISSION DRIVES

See Drives, Chain, Flat Belt and V-Belt

TRAPS, STEAM, MECHANICAL

●American District Steam Co., North Tonawanda, N. Y.
●Anderson Co., V. D., The, Cleveland, O.
●Armstrong Machine Wks., Three Rivers, Mich.
Barnes & Jones, Inc., Jamaica Plain, Boston, Mass.
●Bishop & Babcock Mfg. Co., Cleveland, O.
Boylston Steam Specialty Co., Chicago, Ill.
Bundy Steam Trap Co., Nashua, N. H.
Burrows Mfg. Co., F. A., York, Pa.
Cash Universal Regulator Co., Marshalltown, Ia.
Cashin Co., W. D., Boston, Mass.
●Cochrane Corp., Philadelphia, Pa.
Coe Mfg. Co., Painesville, O.
Crane Co., Chicago, Ill.
Cryer Trap & Valve Co., Inc., New York, N. Y.
Davis Regulator Co., Chicago, Ill.
d'Este Co., Julian, Charlestown, Mass.
●Dunham Co., C. A., Chicago, Ill.
Ellis Drier Co., Chicago, Ill.
Fisher Governor Co., Marshalltown, Ia.
Haines & Co., William S., Philadelphia, Pa.
Healy Ruff Co., St. Paul, Minn.
Hoffman Specialty Co., Inc., Waterbury, Conn.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
●Illinois Engineering Co., Chicago, Ill.
Johnson Corp., Three Rivers, Mich.
Justus Steam Trap Co., Napanoch, N. Y.
Kaye & MacDonald, Inc., West Orange, N. J.
Keckley Co., O. C., Chicago, Ill.
Kieley & Mueller, Inc., New York, N. Y.
Klipfel Mfg. Co., Chicago, Ill.
Lytton Mfg. Co., Franklin, Va.
Marsh Corp., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
McAuley Trap Co., Pittsburgh, Pa.
Milwaukee Valve Co., Milwaukee, Wis.
Monash-Younker Co., Chicago, Ill.
Morehead Mfg. Co., Detroit, Mich.
Mouat Vapor Heating Co., The, Cleveland, O.
Mueller Steam Specialty Co., Inc., New York, N. Y.
Nason Co., Detroit, Mich.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
●Sarco Co., Inc., New York, N. Y.
Schaub Engineering Co., Fred H., Chicago, Ill.
Squires Co., C. E., Cleveland, O.
Star Radiator Co., Los Angeles, Cal.
Sterling Engineering Co., Milwaukee, Wis.
Sterling Engineering & Mfg. Corp., Hyde Park, Mass.
Stickle Steam Specialties Co., Indianapolis, Ind.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Swartwout Co., Cleveland, O.
Templeton Bros., Boston, Mass. (Return)
Trerice Co., H. O., Detroit, Mich.
Vapor Specialty Co., New York, N. Y.
Watson & McDaniel Co., Philadelphia, Pa.
●Webster & Co., Warren, Camden, N. J.
Williams Gauge Co., Pittsburgh, Pa.
Wright-Austin Co., Detroit, Mich.
●Yarnall-Waring Co., Philadelphia, Pa.

TRAPS, STEAM, THERMOSTATIC

●American District Steam Co., North Tonawanda, N. Y.
Barnes & Jones, Inc., Jamaica Plain, Boston, Mass.
●Bishop & Babcock Mfg. Co., Cleveland, O.
Capitol Brass Div., Bohn Aluminum & Brass Corp., Detroit, Mich.
Cashin Co., W. D., Boston, Mass.
●Clifford Mfg. Co., Boston, Mass.
Cryer Trap & Valve Co., Inc., New York, N. Y.
●Dunham Co., C. A., Chicago, Ill.
Haines & Co., William S., Philadelphia, Pa.
Hoffman Specialty Co., Inc., Waterbury, Conn.
Huyette Co., Inc., Paul B., Philadelphia, Pa.
●Illinois Engineering Co., Chicago, Ill.
Marsh Corp., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Monash-Younker Co., Chicago, Ill.
Mouat Vapor Heating Co., The, Cleveland, O.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Pierce, Butler Radiator Corp., Syracuse, N. Y.
●Powers Regulator Co., Chicago, Ill.
●Sarco Co., Inc., New York, N. Y.
Simplex Heating Specialty Co., Inc., Lynchburg, Va.
Sterling Engineering Co., Milwaukee, Wis.
Stickle Steam Specialties Co., Indianapolis, Ind.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Swartwout Co., Cleveland, O.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
●Trane Co., La Crosse, Wis.
Trerice Co., H. O., Detroit, Mich.
Vapor Car Heating Co., Inc., Chicago, Ill.
Vapor Specialty Co., New York, N. Y.
●Webster & Co., Warren, Camden, N. J.

TUBE CLEANERS

See Cleaners, Tube

TUBES, BOILER

Bethlehem Steel Co., Bethlehem, Pa.
Bigelow Co., New Haven, Conn.
Globe Steel Tubes Co., Milwaukee, Wis.
International Engineering Wks., Inc., Framingham, Mass.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
National Tube Co., United States Steel Corp. Sub., Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
●Republic Steel Corp., Cleveland, O.
Standard Tube Co., Highland Park, Mich.
Steel & Tubes, Div. of Republic Steel Corp., Cleveland, O.
Timken Steel & Tube Co., Canton, O.
●Youngstown Sheet & Tube Co., Youngstown, O.

TUBES, PITOT

Bacharach Industrial Instrument Co., Pittsburgh, Pa.
Defender Automatic Regulator Co., St. Louis, Mo.
Detroit Air Meter Co., Detroit, Mich.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
Hill, E. Vernon, Chicago, Ill.
●Meriam Co., The, Cleveland, O.

TUBING, ALUMINUM

Aluminum Co. of America, Pittsburgh, Pa.
Imperial Brass Mfg. Co., Chicago, Ill.

TUBING BENDERS

See Benders, Tubing

TUBING, BRASS AND COPPER

American Brass Co., Waterbury, Conn.
American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Bridgeport Brass Co., Bridgeport, Conn.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
●Hussey & Co., C. G., Pittsburgh, Pa.
Imperial Brass Mfg. Co., Chicago, Ill.
●Mueller Brass Co., Port Huron, Mich.
Parker Appliance Co., Cleveland, O.
Phelps Dodge Copper Products Corp., British American Tube Div., New York, N. Y.
Revere Copper & Brass, Inc., New York, N. Y.
Roberts Tube Works, Detroit, Mich.
Scovill Mfg. Co., Waterville Div., Waterville, Conn.
●Streamline Pipe & Fittings Div., Mueller Brass Co., Port Huron, Mich.
United States Brass & Copper Co., Hyde Park, Boston, Mass.
Wolverine Tube Co., Detroit, Mich.

TUBING CUTTERS

See Cutters, Tubing

TUBING, FINNED

●Aerofin Corp., Syracuse, N. Y.
Bush Mfg. Co., Hartford, Conn.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.
●G. & O. Mfg. Co., New Haven, Conn.
●Industrial Mfg. & Engineering Co., Chicago, Ill.
Kramer Trenton Co., Trenton, N. J.
Manufacturers Fin Coil Co., Chicago, Ill.
●McCord Radiator & Mfg. Co., Detroit, Mich.
●McQuay, Inc., Minneapolis, Minn.
Peerless of America, Inc., Chicago, Ill.
Refrigeration Appliances, Inc., Chicago, Ill.
Refrigeration Economics Co., Inc., Canton, O.
●Rempe Co., Chicago, Ill.
Rome-Turney Radiator Co., Rome, N. Y.
Tilco-Fin, Inc., Brooklyn, N. Y.
Wolverine Tube Co., Detroit, Mich. (Aluminum, copper)

TUBING, STEEL

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Babcock & Wilcox Co., New York, N. Y.
Bethlehem Steel Co., Bethlehem, Pa.
Bundy Tubing Co., Detroit, Mich.
Detroit Seamless Steel Tubes Co., Detroit, Mich.
Globe Steel Tubes Co., Milwaukee, Wis.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Laclede Steel Co., St. Louis, Mo.
National Tube Co., United States Steel Corp. Sub., Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
●Republic Steel Corp., Cleveland, O.
South Chester Tube Co., Chester, Pa.
Spang Chalfant, Inc., Div. of National Supply Co., Pittsburgh, Pa.
Standard Tube Co., Highland Park, Mich.
Steel and Tubes, Div. of Republic Steel Corp., Cleveland, O.
Timken Steel & Tube Co., Canton, O.

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Wheatland Tube Co., Philadelphia, Pa.
●Youngstown Sheet & Tube Co., Youngstown, O.

TUBING, STEEL, STAINLESS

Alloy Steel Products Co., Linden, N. J.
Babcock & Wilcox Co., New York, N. Y.
Carpenter Steel Co., Reading, Pa.
Duraloy Co., Scottdale, Pa.
Globe Steel Tubes Co., Milwaukee, Wis.
International Nickel Co., New York, N. Y.
National Tube Co., United States Steel Corp. Sub., Pittsburgh, Pa.
●Republic Steel Corp., Cleveland, O.
Standard Tube Co., Highland Park, Mich.
Steel and Tubes, Div. of Republic Steel Corp., Cleveland, O.
Timken Steel & Tube Co., Canton, O.

TURBINES, MECHANICAL DRIVE

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Carling Blower Co., Worcester, Mass.
Coppus Engineering Corp., Worcester, Mass.
Dean Hill Pump Co., Anderson, Ind.
De Laval Steam Turbine Co., Trenton, N. J.
Elliott Co., Jeannette, Pa.
General Electric Co., Schenectady, N. Y.
Moore Steam Turbine Corp., Wellsville, N. Y.
Murray Iron Wks. Co., Burlington, Ia.
●Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Terry Steam Turbine Co., Hartford, Conn.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
●Wing Mfg. Co., L. J., New York, N. Y.

2, 3 AND 4-WAY VALVES

See Valves, 2, 3 and 4-way

UNDERGROUND PIPING

See Conduit, Underground Piping

UNIONS, BRASS

Belknap Mfg. Co., Bridgeport, Conn.
Commonwealth Brass Corp., Detroit, Mich.
Crane Co., Chicago, Ill.
●Devlin Mfg. Co., Inc., Thos., Burlington, N. J.
Flagg & Co., Inc., Stanley G., Philadelphia, Pa.
General Fittings Co., Providence, R. I.
Grabler Mfg. Co., Cleveland, O.
Hays Mfg. Co., Erie, Pa.
Jarecki Mfg. Co., Erie, Pa.
Jenkins Mfg. Co., New York, N. Y.
King Union Co., Inc., Hillsgrove, R. I.
Lockport Fittings Co., Inc., Lockport, N. Y.
Lunkenheimer Co., Cincinnati, O.
Milwaukee Valve Co., Milwauke, Wis.
●Mueller Brass Co., Port Huron, Mich.
Ohio Brass Co., Mansfield, O. (Elbows)
Ohio Pattern Wks. & Foundry Co., Eureka Valve Div., Cincinnati, O.
Parker Appliance Co., Cleveland, O.
Phoenix Brass Fittings Corp., Irvington, N. J.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Powell Co., Wm., Cincinnati, O.
Rhode Island Fittings Co., Hillsgrove, R. I.
Standard Union Co., Lockport, N. Y.
●Streamline Pipe & Fittings Div., Mueller Brass Co., Port Huron, Mich.
Walworth Co., New York, N. Y.
Ward Foundries, Inc., J. P., Blossburg, Pa.
Williams Valve Co., D. T., Cincinnati, O.

UNIONS, MALLEABLE, BRASS SEAT

Corley Co., Jersey City, N. J.
Crane Co., Chicago, Ill.
●Dart Mfg. Co., E. M., Providence R. I.
Detroit Brass & Malleable Wks., Detroit, Mich.
●Devlin Mfg. Co., Inc., Thos, Burlington, N. J.
●Fairbanks Co., New York, N. Y.
Flagg & Co., Inc., Stanley G., Philadelphia, Pa.
General Fittings Co., Providence R. I.
Grabler Mfg. Co., Cleveland, O.
●Grinnell Co., Inc., Providence, R. I.
Illinois Malleable Iron Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Jefferson Union Co., Lexington, Mass.
Kennedy Valve Mfg. Co., Elmira, N. Y.
King Union Co., Inc., Hillsgrove, R. I.
Lockport Fittings Co., Inc., Lockport, N. Y.
●Malleable Iron Fittings Co., Branford, Conn.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Rhode Island Fittings Co., Hillsgrove, R. I.
Rockwood Sprinkler Co., Worcester, Mass.
Standard Union Co., Lockport, N. Y.
Star Mfg. Co., Inc., Providence, R. I.
Stockham Pipe Fittings Co., Birmingham, Ala.
United Superior Union Co., Inc., Brooklyn, N. Y.
Walworth Co., New York, N. Y.
Ward Foundries, Inc., J. P., Blossburg, Pa.

UNIONS, STEEL

Alloy Steel Products Co., Linden, N. J.
Central Forging Co., Catawissa, Pa.
Champion Machine & Forging Co., Cleveland, O.
Crane Co., Chicago, Ill.
Rockwood Sprinkler Co., Worcester, Mass.
Roessing Mfg. Co., Pittsburgh, Pa.
Vogt Machine Co., Henry, Louisville, Ky.
Walworth Co., New York, N. Y.
●Watson-Stillman Co., Roselle, N. J.

UNIT COOLERS

See Coolers, Unit

UNIT HEATERS

See Heaters, Unit

UNIT VENTILATORS

See Ventilators, Unit

UNITS, AIR CONDITIONING, CENTRAL STATION TYPE

Self contained blower, heating and/or cooling coil, filter, humidifier unit for remote location and duct air distribution

●Air & Refrigeration Corp., New York, N. Y.
Airtemp, Div. of Chrysler Corp., Dayton, O.
American Blower Corp., Detroit, Mich.
American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Anetsberger Bros., Chicago, Ill.
●Baker Ice Machine Co., Inc., Omaha, Neb.
Betz Air Conditioning Corp., Kansas City, Mo.
Blower Application Co., Milwaukee, Wis.
●Buffalo Forge Co., Buffalo, N. Y.
●Carrier Corp., Syracuse, N. Y.
●Clarage Fan Co., Kalamazoo, Mich.
Corozone Air Conditioning Corp., Cleveland, O.
●Curtis Refrigerating Machine Co., St. Louis, Mo.
Drayer & Hanson, Inc., Los Angeles, Cal.
Fairbanks, Morse & Co., Chicago, Ill.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.
Frigidaire Commercial & Air Conditioning Div., General Motors Sales Corp., Dayton, O.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
General Refrigeration Corp., Beloit, Wis.
Governair Corp., Oklahoma City, Okla.
Hastings Air Conditioning Co., Hastings, Neb.
Hoffman Specialty Co., Inc., Waterbury, Conn.
Howe Ice Machine Co., Chicago, Ill.
Ilg Electric Ventilating Co., Chicago, Ill.
Jaden Mfg. Co., Inc., F., Hastings, Neb.
Kauffman Air Conditioning Corp., St. Louis, Mo.
Kelvinator Div., Nash-Kelvinator Corp., Detroit, Mich.
Kramer Trenton Co., Trenton, N. J.
●McCord Radiator & Mfg. Co., Detroit, Mich.
●McQuay, Inc., Minneapolis, Minn.
Modine Mfg. Co., Racine, Wis.
Niagara Blower Co., New York, N. Y.
Refrigeration Economics Co., Inc., Canton, O.
Simmons Co., Gordon H., Milwaukee, Wis.
●Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Surface Combustion Corp., Toledo, O.
●Trane Co., La Crosse, Wis.
●U. S. Air Conditioning Corp., Minneapolis, Minn.
United States Radiator Corp., Detroit, Mich.
Utica Radiator Corp., Utica, N. Y.
●Westinghouse Electric & Mfg. Co., East Springfield, Mass.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
X L Refrigerating Co., Chicago, Ill.
●York Ice Machinery Corp., York, Pa.
●Young Radiator Co., Racine, Wis.

UNITS, AIR CONDITIONING, HORIZONTAL PACKAGE TYPE

Self contained blower, cooling and/or heating coil, filter, humidifier unit for ceiling or platform location in space condition, for connection to remote compressor or cold water supply, and steam or hot water

Airtemp, Div. of Chrysler Corp., Dayton, O.
American Blower Corp., Detroit, Mich.
American Radiator Co., New York, N. Y.
●Baker Ice Machine Co., Inc., Omaha, Neb.
Betz Air Conditioning Corp., Kansas City, Mo.
●Buffalo Forge Co., Buffalo, N. Y.
●Carrier Corp., Syracuse, N. Y.
●Clarage Fan Co., Kalamazoo, Mich.
Corozone Air Conditioning Corp., Cleveland, O.
●Curtis Refrigerating Machine Co., St. Louis, Mo.
Drayer & Hanson, Inc., Los Angeles, Cal.
Fairbanks, Morse & Co., Chicago, Ill.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.
Frigidaire Commercial & Air Conditioning Div., General Motors Sales Corp., Dayton, O.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
General Refrigeration Corp., Beloit, Wis.
Hoffman Specialty Co., Inc., Waterbury, Conn.
Ilg Electric Ventilating Co., Chicago, Ill.

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Jaden Mfg. Co., Inc., F., Hastings, Neb.
Kauffman Air Conditioning Corp., St. Louis, Mo.
Kelvinator Div., Nash-Kelvinator Corp., Detroit, Mich.
Kramer Trenton Co., Trenton, N. J.
●McCord Radiator & Mfg. Co., Detroit, Mich.
●McQuay, Inc., Minneapolis, Minn.
Modine Mfg. Co., Racine, Wis.
Niagara Blower Co., New York, N. Y.
Red Jacket Mfg. Co., Davenport, Ia.
Refrigeration Economics Co., Inc., Canton, O.
●Sturtevant Co., B. F., Boston, Mass.
●Trane Co., La Crosse, Wis.
●U. S. Air Conditioning Corp., Minneapolis, Minn.
United States Radiator Corp., Detroit, Mich.
●Webster & Co., Warren, Camden, N. J.
●Westinghouse Electric & Mfg. Co., East Springfield, Mass.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
X L Refrigerating Co., Chicago, Ill.
●York Ice Machinery Corp., York, Pa.
●Young Radiator Co., Racine, Wis.

UNITS, AIR CONDITIONING, INDUSTRIAL TYPE

●Air & Refrigeration Corp., New York, N. Y.
American Blower Corp., Detroit, Mich.
Anetsberger Bros., Chicago, Ill.
Bahnson Co., Winston-Salem, N. C.
●Baker Ice Machine Co., Inc., Omaha, Neb.
Betz Air Conditioning Corp., Kansas City, Mo.
Brundage Co. Kalamazoo, Mich.
●Buffalo Forge Co., Buffalo, N. Y.
●Carrier Corp., Syracuse, N. Y.
●Clarage Fan Co., Kalamazoo, Mich.
●Curtis Refrigerating Machine Co., St. Louis, Mo.
Drayer & Hanson, Inc., Los Angeles, Cal.
Economy Equipment Co., Inc., Chicago, Ill.
Fairbanks, Morse & Co., Chicago, Ill.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.
●Frick Co., Waynesboro, Pa.
General Refrigeration Corp., Beloit, Wis.
Howe Ice Machine Co., Chicago, Ill.
●Industrial Mfg. & Engineering Co., Chicago, Ill.
International Moistening Co., Providence, R. I.
Jaden Mfg. Co., Inc., F., Hastings, Neb.
Kauffman Air Conditioning Corp., St. Louis, Mo.
●McQuay, Inc., Minneapolis, Minn.
Niagara Blower Co., New York, N. Y.
Parks-Cramer Co., Fitchburg, Mass.
Pfening Co., Fred D., Columbus, O.
Refrigeration Economics Co., Inc., Canton, O.
Research Corp., New York, N. Y.
Ross Engineering Corp., J. O., New York, N. Y.
Somers, Inc., H. J., Detroit, Mich.
●Sturtevant Co., B. F., Hyde Park, Boston, Mass.
●Trane Co., La Crosse, Wis.
●Vilter Mfg. Co., Milwaukee, Wis.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
X L Refrigerating Co., Chicago, Ill.
●York Ice Machinery Corp., York, Pa.
●Young Radiator Co., Racine, Wis.

UNITS, AIR CONDITIONING, SUMMER, EVAPORATIVE TYPE

For cooling with sprays, no dehumidification

●Air & Refrigeration Corp., New York, N. Y.
Air-O-Line Co., The, Dallas, Tex.
Atlas Heating & Ventilating Co., Ltd., San Francisco, Cal.
Coolmaster Corp., Chicago, Ill.
Economy Electric Mfg. Co., Chicago, Ill.
Fairbanks, Morse & Co., Chicago, Ill.
●Hall Mfg. Co., Cedar Rapids, Ia.
Montag Stove & Furnace Works, Portland, Ore.
Mountain States Equipment Co., Denver, Colo.
Palmer's Mfg. Corp., Phoenix, Ariz.
Pernot & Rich, Inc., Los Angeles, Cal.
Star Radiator Co., Los Angeles, Cal.
Todd Air Conditioning Co., Inc., Bonner Springs, Kans.
●U. S. Air Conditioning Corp., Minneapolis, Minn.
Utility Fan Corp., Los Angeles, Cal.
Western Blower Co., Seattle, Wash.
X L Refrigerating Co., Chicago, Ill.

UNITS, AIR CONDITIONING, SUMMER, ROOM TYPE, FLOOR CABINET, REMOTE COMPRESSOR OR COLD WATER, UNDER 3 TONS CAPACITY

Self contained blower, coil, filter unit for connection to remote compressor or cold water supply

Airgard Mfg. Co., Chicago, Ill.
Airtemp, Div. of Chrysler Corp., Dayton, O.
Ballantyne Co., Omaha, Neb.
●Carrier Corp., Syracuse, N. Y.
●Dunham Co., C. A., Chicago, Ill.
Fairbanks, Morse & Co., Chicago, Ill.
Frigidaire Commercial & Air Conditioning Div., General Motors Sales Corp., Dayton, O.
General Air Conditioning Corp., Cincinnati, O.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
Giant Mfg. Co., Council Bluffs, Ia.
Governair Corp., Oklahoma City, Okla.
Hastings Air Conditioning Co., Hastings, Neb.
Ilg Electric Ventilating Co., Chicago, Ill.
Jaden Mfg. Co., Inc., F., Hastings, Neb.
Kauffman Air Conditioning Corp., St. Louis, Mo.
Kelvinator Div., Nash-Kelvinator Corp., Detroit, Mich.
Kennard, Inc., Sam, St. Louis, Mo.
King Ventilating Co., Owatonna, Minn.
●McQuay, Inc., Minneapolis, Minn.
●Nesbitt, Inc., John J., & Buckeye Blower Co., Philadelphia, Pa.
Norge Div., Borg-Warner Corp., Detroit, Mich.
Norwin Co., Freeport, Ill.
Perham Products, Inc., Chicago, Ill.
Standard Air Conditioning, Inc., New York, N. Y.
●Trane Co., La Crosse, Wis.
Unified Air Conditioner Co., Duluth, Minn.
●Westinghouse Electric & Mfg. Co., East Springfield, Mass.
Western Blower Co., Seattle, Wash.
X L Refrigerating Co., Chicago, Ill.
●York Ice Machinery Corp., York, Pa.

UNITS, AIR CONDITIONING, SUMMER, ROOM TYPE, FLOOR CABINET, SELF CONTAINED COMPRESSOR, UNDER 3 HP

Self contained blower, coil, compressor, filter unit

Airtemp, Div. of Chrysler Corp., Dayton, O.
Apex Rotarex Corp., Cleveland, O.
●Carrier Corp., Syracuse, N. Y.
Corozone Air Conditioning Corp., Cleveland, O.
●Curtis Refrigerating Machine Co., St. Louis, Mo.
Electrol, Inc., Clifton, N. J.
Fairbanks, Morse & Co., Chicago, Ill.
Frigidaire Commercial & Air Conditioning Div., General Motors Sales Corp., Dayton, O.
Gale Products, Galesburg, Ill.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
General Refrigeration Corp., Beloit, Wis.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Harvey-Whipple, Inc., Springfield, Mass.
Ice Cooling Appliance Corp., Morrison, Ill. (Ice)
Ilg Electric Ventilating Co., Chicago, Ill.
Indian Trailer Corp., Koolroom Div., Chicago, Ill.
Kauffman Air Conditioning Corp., St. Louis, Mo.
Kelvinator Div., Nash-Kelvinator Corp., Detroit, Mich.
Mayflower Air-Conditioners, Inc., St. Paul, Minn.
National Standard Air Products Co., Chicago, Ill.
Norge Div., Borg-Warner Corp., Detroit, Mich.
Philco Radio & Television Corp., Philadelphia, Pa.
Pleasantaire Corp., Washington, D. C.
Standard Air Conditioning, Inc., New York, N. Y.
●Trane Co., La Crosse, Wis.
●Westinghouse Electric & Mfg. Co., East Springfield, Mass.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
●York Ice Machinery Corp., York, Pa.

UNITS, AIR CONDITIONING, SUMMER, STORE TYPE, FLOOR CABINET, SELF CONTAINED COMPRESSOR, 3 HP AND OVER

Self contained blower, coil, compressor, filter unit with air discharge approximately 6 ft. above floor

Airtemp, Div., of Chrysler Corp., Dayton, O.
●Baker Ice Machine Co., Inc., Omaha, Neb.
●Buffalo Forge Co., Buffalo, N. Y.
●Carrier Corp., Syracuse, N. Y.
●Clarage Fan Co., Kalamazoo, Mich.
●Curtis Refrigerating Machine Co., St. Louis, Mo.
Fairbanks, Morse & Co., Chicago, Ill.
Forman Machine & Electric Corp., New York, N. Y.
●Frick Co., Waynesboro, Pa.
Frigidaire Commercial & Air Conditioning Div., General Motors Sales Corp., Dayton, O.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
General Refrigeration Corp., Beloit, Wis.
Kauffman Air Conditioning Corp., St. Louis, Mo.
Kelvinator Div., Nash-Kelvinator Corp., Detroit, Mich.
Niagara Blower Co., New York, N. Y.
Norge Div., Borg-Warner Corp., Detroit, Mich.
Standard Air Conditioning, Inc., New York, N. Y.
●Trane Co., La Crosse, Wis.
●Vilter Mfg. Co., Milwaukee, Wis.
●Westinghouse Electric & Mfg. Co., East Springfield, Mass.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
●York Ice Machinery Corp., York, Pa.

UNITS, AIR CONDITIONING, WINTER, ROOM TYPE, FLOOR CABINET

Self contained blower, filter, heating coil, humidifier unit

●Air & Refrigeration Corp., New York, N. Y.
Apex Rotarex Corp., Cleveland, O.
●Burnham Boiler Corp., Irvington, N. Y.
Campbell Heating Co., Des Moines, Ia.
●Carrier Corp., Syracuse, N. Y.
●Clarage Fan Co., Kalamazoo, Mich.
Drayer & Hanson, Inc., Los Angeles, Cal.

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●Dunham Co., C. A., Chicago, Ill.
Easternoil, Inc., Portland, Me.
Electrol, Inc., Clifton, N. J.
Fairbanks, Morse & Co., Chicago, Ill.
Frigidaire Commercial & Air Conditioning Div., General Motors Sales Corp., Dayton, O.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
Ilg Electric Ventilating Co., Chicago, Ill.
Kauffman Air Conditioning Corp., St. Louis, Mo.
●McQuay, Inc., Minneapolis, Minn.
Nelson Corp., Herman, Moline, Ill.
●Nesbitt, Inc., John J., & Buckeye Blower Co., Philadelphia, Pa.
Norge Div., Borg-Warner Corp., Detroit, Mich.
Perham Products, Inc., Chicago, Ill.
Reznor Mfg. Co., Mercer, Pa.
Somers, Inc., H. J., Detroit, Mich.
Standard Air Conditioning, Inc., New York, N. Y.
Surface Combustion Corp., Toledo, O.
●Trane Co., La Crosse, Wis.
●U. S. Air Conditioning Corp., Minneapolis, Minn.
Unified Air Conditioner Co., Duluth, Minn.
●Westinghouse Electric & Mfg. Co., East Springfield, Mass.
●York Ice Machinery Corp., York, Pa.
●Young Radiator Co., Racine, Wis.

UNITS, AIR CONDITIONING, YEAR AROUND, ROOM TYPE, FLOOR CABINET

Self contained blower, cooling and heating coil, filter, humidifier unit for connection to remote compressor or cold water supply, and steam or hot water supply

●Air & Refrigeration Corp., New York, N. Y.
Airtemp, Div. of Chrysler Corp., Dayton, O.
Apex Rotarex Corp., Cleveland, O.
●Baker Ice Machine Co., Inc., Omaha, Neb.
Betz Air Conditioning Corp., Kansas City, Mo.
●Carrier Corp., Syracuse, N. Y.
●Clarage Fan Co., Kalamazoo, Mich.
Corozone Air Conditioning Corp., Cleveland, O.
●Curtis Refrigerating Machine Co., St. Louis, Mo.
●Dunham Co., C. A., Chicago, Ill.
Fairbanks, Morse & Co., Chicago, Ill.
Frigidaire Commercial & Air Conditioning Div., General Motors Sales Corp., Dayton, O.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Bloomfield, N. J.
General Refrigeration Corp., Beloit, Wis.
●Grinnell Co., Inc., Providence, R. I.
Hastings Air Conditioning Co., Hastings, Neb.
Ilg Electric Ventilating Co., Chicago, Ill.
Jaden Mfg. Co., Inc., F., Hastings, Neb.
Kauffman Air Conditioning Corp., St. Louis, Mo.
Kelvinator Div., Nash-Kelvinator Corp., Detroit, Mich.
Kennard, Inc., Sam, St. Louis, Mo.
Modine Mfg. Co., Racine, Wis.
Nelson Corp., Herman, Moline, Ill.
●Nesbitt, Inc., John J., & Buckeye Blower Co., Philadelphia, Pa.
Norge Div., Borg-Warner Corp., Detroit, Mich.
Perham Products, Inc., Chicago, Ill.
Standard Air Conditioning, Inc., New York, N. Y.
●Trane Co., La Crosse, Wis.
Unified Air Conditioner Co., Duluth, Minn.
●Westinghouse Electric & Mfg. Co., East Springfield, Mass.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
●York Ice Machinery Corp., York, Pa.

UNITS, WINDOW VENTILATOR AND FILTER

Ad-Lee Co., Inc., Chicago, Ill.
Airgard Mfg. Co., Chicago, Ill.
Amirton Co., New York, N. Y.
Berger Mfg. Div., Republic Steel Corp., Canton, O.
Burrowes Corp., Portland, Me.
●Carrier Corp., Syracuse, N. Y.
Davies Air Filter Corp., New York, N. Y.
General Refrigeration Corp., Beloit, Wis.
Ilg Electric Ventilating Co., Chicago, Ill.
Jaden Mfg. Co., Inc., F., Hastings, Neb.
Kaiser Co., H. S., Chicago, Ill.
Kauffman Air Conditioning Corp., St. Louis, Mo.
Mellish & Murray Co., Chicago, Ill.
National Standard Air Products Co., Chicago, Ill.
Reed Unit-Fans, Inc., New Orleans, La.
Schwitzer-Cummins Co., Indianapolis, Ind.
Somers, Inc., H. J., Detroit, Mich.
Standard Air Conditioning, Inc., New York, N. Y.
●Staynew Filter Corp., Rochester, N. Y.
Todd Air Conditioning Co., Inc., Bonner Springs, Kans.
●U. S. Air Conditioning Corp., Minneapolis, Minn.
Unified Air Conditioner Co., Duluth, Minn.
Utility Fan Corp., Los Angeles, Cal.

VACUUM GAGES

See Gages, Indicating, Vacuum

VACUUM HEATING SYSTEMS

See Systems, Heating, Vacuum

VACUUM PUMPS

See Pumps, Vacuum Heating

VACUUM RECORDERS

See Recorders, Pressure and Vacuum

VALVE OPERATORS

See Operators, Valve

VALVE RESEATERS

See Reseaters, Valve

VALVES, ANGLE

Alloy Steel Products Co., Linden, N. J.
●American Brass Co., Waterbury, Conn.
Belfield Co., H., Philadelphia, Pa.
Belknap Mfg. Co., Bridgeport, Conn.
Capitol Brass Div., Bohn Aluminum & Brass Corp., Detroit, Mich.
Central Brass Mfg. Co., Cleveland, O.
Central Valve Mfg. Co., Chicago, Ill.
Chapman Valve Mfg. Co., The, Indian Orchard, Mass.
Crane Co., Chicago, Ill.
Detroit Brass & Malleable Wks., Detroit, Mich.
Edward Valve & Mfg. Co., Inc., East Chicago, Ind.
Everlasting Valve Co., Jersey City, N. J.
●Fairbanks Co., New York, N. Y.
Gorton Heating Corp., Cranford, N. J.
●Grinnell Co., Inc., Providence, R. I.
Hasco Valve & Machine Co., Milwaukee, Wis.
Homestead Valve Mfg. Co., Coraopolis, Pa.
Imperial Brass Mfg. Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Jenkins Bros., New York, N. Y.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Klingerit, Inc., New York, N. Y.
Lunkenheimer Co., Cincinnati, O.
Luzerne Rubber Co., Trenton, N. J. (Hard rubber)
Manning, Maxwell & Moore, Inc., Hancock Valve Div., Bridgeport, Conn.
Milwaukee Valve Co., Milwaukee, Wis.
Monat Valve & Forge Co., Inc., Pittsburgh, Pa.
●Mueller Brass Co., Port Huron, Mich.
Northern Indiana Brass Co., Elkhart, Ind.
Ohio Brass Co., Mansfield, O.
Ohio Injector Co., Wadsworth, O.
Ohio Pattern Wks. & Foundry Co., Eureka Valve Div., Cincinnati, O.
Parker Appliance Co., Cleveland, O.
Pierce, Butler Radiator Corp., Syracuse, N. Y.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Powell Co., Wm., Cincinnati, O.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Rockford Brass Works, Rockford, Ill.
Stockham Pipe Fittings Co., Birmingham, Ala.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Walworth Co., New York, N. Y.
White Flo-Matic Corp., Hoosick Falls, N. Y.
Williams Valve Co., D. T., Cincinnati, O.

VALVES, BLOW-OFF

Alloy Steel Products Co., Linden, N. J.
Babcock & Wilcox Co., New York, N. Y.
Barrett Machine Co., N. S. Pittsburgh, Pa.
Bordo Co., Inc., L. J., Glenside, Pa.
Central Valve Mfg. Co., Chicago, Ill.
Chapman Valve Mfg. Co., The, Indian Orchard, Mass.
Clees Valve & Engineering Co., New York, N. Y.
Crane Co., Chicago, Ill.
Eclipse Fuel Engineering Co., Rockford, Ill.
Edward Valve & Mfg. Co., Inc., East Chicago, Ind.
Elliott Co., Jeannette, Pa.
Everlasting Valve Co., Jersey City, N. J.
●Fairbanks Co., New York, N. Y.
Homestead Valve Mfg. Co., Coraopolis, Pa.
Jarecki Mfg. Co., Erie, Pa.
Jenkins Bros., New York, N. Y.
Keckley Co., O. C., Chicago, Ill.
Ludlow Valve Mfg. Co., Troy, N. Y.
Lunkenheimer Co., Cincinnati, O.
Manning, Maxwell & Moore, Inc., Hancock Valve Div., Bridgeport, Conn.
Merco Nordstrom Valve Co., Pittsburgh, Pa.
Norgren Co., Inc., C. A., Denver, Colo.
Ohio Injector Co., Wadsworth, O.
Parker Appliance Co., Cleveland, O.
Powell Co., Wm., Cincinnati, O.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Walworth Co., New York, N. Y.
●Yarnall-Waring Co., Philadelphia, Pa.

VALVES, CHECK

Alloy Steel Products Co., Linden, N. J.
American Hard Rubber Co., New York, N. Y. (Hard rubber)
Atlantic Valve & Pump Co., Chicago, Ill.
Barrett, Haentjens & Co., Hazleton, Pa.
Belfield Co., H., Philadelphia, Pa.
Belknap Mfg. Co., Bridgeport, Conn.
Capitol Brass Div., Bohn Aluminum & Brass Corp., Detroit, Mich.
Central Forging Co., Catawissa, Pa.
Central Valve Mfg. Co., Chicago, Ill.
Chapman Valve Mfg. Co., The, Indian Orchard, Mass.
Cooper Co., Clark, Philadelphia, Pa.
Crane Co., Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Detroit Brass & Malleable Wks., Detroit, Mich.

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Eclipse Fuel Engineering Co., Rockford, Ill.
Eddy Valve Co., Waterford, N. Y.
Edward Valve & Mfg. Co., Inc., East Chicago, Ind.
●Fairbanks Co., New York, N. Y.
Foster Engineering Co., Newark, N. J.
Golden-Anderson Valve Specialty Co., Pittsburgh, Pa.
●Grinnell Co., Inc., Providence, R. I.
Hasco Valve & Machine Co., Milwaukee, Wis.
●Henry Valve Co., Chicago, Ill.
Illinois Malleable Iron Co., Chicago, Ill.
Imperial Brass Mfg. Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Jenkins Bros., New York, N. Y.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Locke Regulator Co., Salem, Mass.
Ludlow Valve Mfg. Co., Troy, N. Y.
Lunkenheimer Co., Cincinnati, O.
Luzerne Rubber Co., Trenton, N. J. (Hard rubber)
Manning, Maxwell & Moore, Inc., Hancock Valve Div., Bridgeport, Conn.
Milwaukee Valve Co., Milwaukee, Wis.
Mueller Co., Decatur, Ill.
●Mueller Brass Co., Port Huron, Mich.
Norgren Co., Inc., C. A., Denver, Colo.
Ohio Brass Co., Mansfield, O.
Ohio Injector Co., Wadsworth, O.
Ohio Pattern Wks. & Foundry Co., Eureka Valve Div., Cincinnati, O.
Parker Appliance Co., Cleveland, O.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Powell Co., Wm., Cincinnati, O.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Rockford Brass Works, Rockford, Ill.
Ruggles-Klingemann Mfg. Co., Salem, Mass. (Bleeder type)
Schutte & Koerting Co., Philadelphia, Pa.
Smolensky Valve Co., Inc., Cleveland, O.
Stockham Pipe Fittings Co., Birmingham, Ala.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Walworth Co., New York, N. Y.
●Watson-Stillman Co., Roselle, N. J.
White Flo-Matic Corp., Hoosick Falls, N. Y.
Williams Gauge Co., Pittsburgh, Pa. (Noiseless)
Williams Valve Co., D. T., Cincinnati, O.

VALVES, DIAPHRAGM

Atlas Valve Co., Inc., Newark, N. J.
Belfield Co., H., Philadelphia, Pa.
Boylston Steam Specialty Co., Chicago, Ill.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
●Cash Co., A. W., Decatur, Ill.
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
Cooper Co., Clark, Philadelphia, Pa.
Davis Regulator Co., Chicago, Ill.
Defender Automatic Regulator Co., St. Louis, Mo.
d'Este Co., Julian, Charlestown, Mass.
Eclipse Fuel Engineering Co., Rockford, Ill.
Fisher Governor Co., Marshalltown, Ia.
Foster Engineering Co., Newark, N. J.
Foxboro Co., Foxboro, Mass.
Friez & Sons, Julien P., Baltimore, Md.
General Controls Co., Glendale, Cal.
Golden-Anderson Valve Specialty Co., Pittsburgh, Pa.
●Illinois Engineering Co., Chicago, Ill.
●Johnson Service Co., Milwaukee, Wis.
Kieley & Mueller Co., Inc., New York, N. Y.
Klipfel Mfg. Co., Chicago, Ill.
Locke Regulator Co., Salem, Mass.
Mason-Neilan Regulator Co., Boston, Mass.
McAlear Mfg. Co., Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
●Mueller Brass Co., Port Huron, Mich.
Mueller Co., Decatur, Ill.
Mueller Steam Specialty Co., Inc., New York, N. Y.
Northern Indiana Brass Co., Elkhart, Ind.
Parks-Cramer Co., Fitchburg, Mass.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
Powell Co., Wm., Cincinnati, O.
●Powers Regulator Co., Chicago, Ill.
Ruggles-Klingemann Mfg. Co., Salem, Mass.
Schade Valve Mfg. Co., Philadelphia, Pa.
Schutte & Koerting Co., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Spencer Thermostat Co., Attleboro, Mass.
Staples & Pfeiffer, Ltd., San Francisco, Cal.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Swartwout Co., Cleveland, O.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
●Trane Co., La Crosse, Wis.
Trerice Co., H. O., Detroit, Mich.
Watson & McDaniel Co., Philadelphia, Pa.
Watts Regulator Co., Lawrence, Mass.
White-Rodgers Electric Co., St. Louis, Mo.

VALVES, FLOAT

Atlas Valve Co., Inc., Newark, N. J.
●Automatic Products Co., Milwaukee, Wis. (Oil)
Belfield Co., H., Philadelphia, Pa.
Boylston Steam Specialty Co., Chicago, Ill.
Caldwell Co., W. E., Louisville, Ky.
●Cash Co., A. W., Decatur, Ill.
Central Brass Mfg. Co., Cleveland, O.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Cooper Co., Clark, Philadelphia, Pa.
Crane Co., Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Davis Regulator Co., Chicago, Ill.
Defender Automatic Regulator Co., St. Louis, Mo.
d'Este Co., Julian, Charlestown, Mass.
Eclipse Fuel Engineering Co., Rockford, Ill.
Eddy Valve Co., Waterford, N. Y.
Fisher Governor Co., Marshalltown, Ia.
Foster Engineering Co., Newark, N. J.
Golden-Anderson Valve Specialty Co., Pittsburgh, Pa.
Hasco Valve & Machine Co., Milwaukee, Wis.
●Illinois Engineering Co., Chicago, Ill.
Imperial Brass Mfg. Co., Chicago, Ill.
Kieley & Mueller Co., Inc., New York, N. Y.
Klipfel Mfg. Co., Chicago, Ill.
Locke Regulator Co., Salem, Mass.
Ludlow Valve Mfg. Co., Troy, N. Y.
Luzerne Rubber Co., Trenton, N. J. (Hard rubber)
●Maid-O-Mist, Inc., Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
McAlear Mfg. Co., Chicago, Ill.
Monash-Younker Co., Chicago, Ill.
●Mueller Brass Co., Port Huron, Mich.
Mueller Steam Specialty Co., Inc., New York, N. Y.
Rockford Brass Works, Rockford, Ill.
Ross Valve Mfg. Co., Inc., Troy, N. Y.
Ruggles-Klingemann Mfg. Co., Salem, Mass.
Schade Valve Mfg. Co., Philadelphia, Pa.
Schutte & Koerting Co., Philadelphia, Pa.
Spence Engineering Co., Inc., Walden, N. Y.
Stickle Steam Specialties Co., Indianapolis, Ind.
Swartwout Co., Cleveland, O.
●Trane Co., La Crosse, Wis.
Viking Air Conditioning Corp., Cleveland, O.
Voss Co., J. H. H., New York, N. Y.
Watts Regulator Co., Lawrence, Mass.

VALVES, FORGED STEEL

Central Valve Mfg. Co., Chicago, Ill.
Chapman Valve Mfg. Co., The, Indian Orchard, Mass.
Clees Valve & Engineering Co., New York, N. Y.
Crane Co., Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Edward Valve & Mfg. Co., Inc., East Chicago, Ind.
Everlasting Valve Co., Jersey City, N. J.
●Henry Valve Co., Chicago, Ill.
Manning, Maxwell & Moore, Inc., Hancock Valve Div., Bridgeport, Conn.
Merco Nordstrom Valve Co., Pittsburgh, Pa.
Parker Appliance Co., Cleveland, O.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Schutte & Koerting Co., Philadelphia, Pa.
Steel Improvement & Forge Co., Cleveland, O.
Vogt Machine Co., Henry, Louisville, Ky.
Walworth Co., New York, N. Y.

VALVES, GATE, BRASS AND BRONZE

●American Brass Co., Waterbury, Conn.
American Injector Co., Detroit, Mich.
Belknap Mfg. Co., Bridgeport, Conn.
Bordo Co., Inc., L. J., Glenside, Pa.
Capitol Brass Div., Bohn Aluminum & Brass Corp., Detroit, Mich.
Chapman Valve Mfg. Co., The, Indian Orchard, Mass.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Crane Co., Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Detroit Brass & Malleable Wks., Detroit, Mich.
●Detroit Lubricator Co., Detroit, Mich.
Eddy Valve Co., Waterford, N. Y.
Everlasting Valve Co., Jersey City, N. J.
●Fairbanks Co., New York, N. Y.
Hammond Brass Wks., Hammond, Ind.
Hoffman Specialty Co., Inc., Waterbury, Conn.
Jarecki Mfg. Co., Erie, Pa.
Jenkins Bros., New York, N. Y.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Ludlow Valve Mfg. Co., Troy, N. Y.
Lunkenheimer Co., Cincinnati, O.
Manning, Maxwell & Moore, Inc., Hancock Valve Div., Bridgeport, Conn.
Milwaukee Valve Co., Milwaukee, Wis.
Monat Valve & Forge Co., Inc., Pittsburgh, Pa.
Northern Indiana Brass Co., Elkhart, Ind.
Ohio Brass Co., Mansfield, O.
Ohio Injector Co., Wadsworth, O.
Ohio Pattern Wks. & Foundry Co., Eureka Valve Div., Cincinnati, O.
Parker Appliance Co., Cleveland, O.

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Phoenix Brass Fittings Corp., Irvington, N. J.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Powell Co., Wm., Cincinnati, O.
R-S Products Corp., Philadelphia, Pa.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Rockford Brass Works, Rockford, Ill.
Scott Valve Mfg. Co., Detroit, Mich.
Stockham Pipe Fittings Co., Birmingham, Ala.
Walworth Co., New York, N. Y.
Williams Valve Co., D. T., Cincinnati, O.

VALVES, GATE, IRON BODY

Berger Bros. Co., Philadelphia, Pa.
Bordo Co., Inc., L. J., Glenside, Pa.
Chapman Valve Mfg. Co., The, Indian Orchard, Mass.
Crane Co., Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eclipse Fuel Engineering Co., Rockford, Ill.
Eddy Valve Co., Waterford, N. Y.
Everlasting Valve Co., Jersey City, N. J.
●Fairbanks Co., New York, N. Y.
Hasco Valve & Machine Co., Milwaukee, Wis.
Illinois Malleable Iron Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Jenkins Bros., New York, N. Y.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Ludlow Valve Mfg. Co., Troy, N. Y.
Lunkenheimer Co., Cincinnati, O.
Monat Valve & Forge Co., Inc., Pittsburgh, Pa.
Ohio Injector Co., Wadsworth, O.
Pittsburgh Valve & Fittings Co., Barberton, O.
Powell Co., Wm., Cincinnati, O.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc. Bridgeport, Conn.
R-S Products Corp., Philadelphia, Pa.
Rensaeller Valve Co., Cohoes, N. Y.
Scott Valve Mfg. Co., Detroit, Mich.
Semet-Solvay Engineering Corp., New York, N. Y.
Walworth Co., New York, N. Y.
Williams Valve Co., D. T., Cincinnati, O.

VALVES, GATE, STEEL

Alloy Steel Products Co., Linden, N. J.
Bordo Co., Inc., L. J., Glenside, Pa.
Central Brass Mfg. Co., Cleveland, O.
Chapman Valve Mfg. Co., The, Indian Orchard, Mass.
Crane Co., Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Everlasting Valve Co., Jersey City, N. J.
Hasco Valve & Machine Co., Milwaukee, Wis.
Jenkins Bros., New York, N. Y.
Ludlow Valve Mfg. Co., Troy, N. Y.
Lunkenheimer Co., Cincinnati, O.
Manning, Maxwell & Moore, Inc., Hancock Valve Div., Bridgeport, Conn.
Monat Valve & Forge Co., Inc., Pittsburgh, Pa.
Parker Appliance Co., Cleveland, O.
Powell Co., Wm., Cincinnati, O.
R-S Products Corp., Philadelphia, Pa.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Walworth Co., New York, N. Y.

VALVES, GLOBE, BRASS AND BRONZE

●American Brass Co., Waterbury, Conn.
American Injector Co., Detroit, Mich.
Belfield Co., H., Philadelphia, Pa.
Belknap Mfg. Co., Bridgeport, Conn.
Capitol Brass Div., Bohn Aluminum & Brass Corp., Detroit, Mich.
Central Valve Mfg. Co., Chicago, Ill.
Chapman Valve Mfg. Co., The, Indian Orchard, Mass.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Crane Co., Chicago, Ill.
Detroit Brass & Malleable Wks., Detroit, Mich.
●Detroit Lubricator Co., Detroit, Mich.
●Fairbanks Co., New York, N. Y.
●Grinnell Co., Inc., Providence, R. I.
Hammond Brass Wks., Hammond, Ind.
Imperial Brass Mfg. Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Jenkins Bros., New York, N. Y.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Klingerit, Inc., New York, N. Y.
Lunkenheimer Co., Cincinnati, O.
Manning, Maxwell & Moore, Inc., Hancock Valve Div., Bridgeport, Conn.
Milwaukee Valve Co., Milwaukee, Wis.
Monat Valve & Forge Co., Inc., Pittsburgh, Pa.
Northern Indiana Brass Co., Elkhart, Ind.
Ohio Brass Co., Mansfield, O.
Ohio Injector Co., Wadsworth, O.
Ohio Pattern Wks. & Foundry Co., Eureka Valve Div., Cincinnati, O.
Parker Appliance Co., Cleveland, O.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Powell Co., Wm., Cincinnati, O.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Rockford Brass Works, Rockford, Ill.
Stockham Pipe Fittings Co., Birmingham, Ala.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Walworth Co., New York, N. Y.
●Watson-Stillman Co., Roselle, N. Y.
White Flo-Matic Corp., Hoosick Falls, N. Y.
Williams Valve Co., D. T., Cincinnati, O.

VALVES, GLOBE, IRON BODY

Belfield Co., H., Philadelphia, Pa.
Chapman Valve Mfg. Co., The, Indian Orchard, Mass.
Crane Co., Chicago, Ill.
Edward Valve & Mfg. Co., Inc., East Chicago, Ind.
●Fairbanks Co., New York, N. Y.
Jarecki Mfg. Co., Erie, Pa.
Jenkins Bros., New York, N. Y.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Klingerit, Inc., New York, N. Y.
Lunkenheimer Co., Cincinnati, O.
McAlear Mfg. Co., Chicago, Ill.
Monat Valve & Forge Co., Inc., Pittsburgh, Pa.
Ohio Injector Co., Wadsworth, O.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Powell Co., Wm., Cincinnati, O.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Shank Co., Cyrus, Chicago, Ill.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Walworth Co., New York, N. Y.
Williams Valve Co., D. T., Cincinnati, O.

VALVES, GLOBE, STEEL

Alloy Steel Products Co., Linden, N. J.
Belfield Co., H., Philadelphia, Pa.
Chapman Valve Mfg. Co., The, Indian Orchard, Mass.
Clees Valve & Engineering Co., New York, N. Y.
Crane Co., Chicago, Ill.
Edward Valve & Mfg. Co., Inc., East Chicago, Ind.
Hasco Valve & Machine Co., Milwaukee, Wis.
Jarecki Mfg. Co., Erie, Pa.
Jenkins Bros., New York, N. Y.
Klingerit, Inc., New York, N. Y.
Lunkenheimer Co., Cincinnati, O.
Manning, Maxwell & Moore, Inc., Hancock Valve Div., Bridgeport, Conn.
McAlear Mfg. Co., Chicago, Ill.
Monat Valve & Forge Co., Inc., Pittsburgh, Pa.
Ostlind Valve, Inc., Portland, Ore.
Parker Appliance Co., Cleveland, O.
Powell Co., Wm., Cincinnati, O.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Schutte & Koerting Co., Philadelphia, Pa.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Walworth Co., New York, N. Y.

VALVES, LINED

American Hard Rubber Co., New York, N. Y. (Hard rubber lined)
Bordo Co., Inc., L. J., Glenside, Pa. (Lead, copper, tin, etc.)
Chapman Valve Mfg. Co., The, Indian Orchard, Mass.
Goodrich Co., B. F., Akron, O. (Rubber lined)
Hasco Valve & Machine Co., Milwaukee, Wis. (Rubber)
Jenkins Bros., New York, N. Y.
Lead Lined Iron Pipe Co., Wakefield, Mass. (Lead or tin)
National Lead Co., New York, N. Y. (Lead)
Northern Indiana Brass Co., Elkhart, Ind. (Tinned)
Resisto Pipe & Valve Co., East Cambridge, Mass. (Lead)
Schutte & Koerting Co., Philadelphia, Pa. (Lead)

VALVES, MIXING, STEAM AND WATER

Atlantic Valve & Pump Co., Chicago, Ill.
●Bell & Gossett Co., Chicago, Ill.
Boiler Room Equipment, Inc., New York, N. Y.
Central Brass Mfg. Co., Cleveland, O.
Cooper Co., Clark, Philadelphia, Pa.
●Fulton Sylphon Co., Knoxville, Tenn.
●Johnson Service Co., Milwaukee, Wis.
Lawler Automatic Controls, Inc., Mount Vernon, N. Y.
Leonard Valve Co., Providence, R. I.
Leslie Co., Lyndhurst, N. J.
●Powers Regulator Co., Chicago, Ill.
●Sarco Co., Inc., New York, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
Sterling Engineering Co., Milwaukee, Wis.
Thermo-Mix, Inc., Brooklyn, N. Y. (Thermostatic mixing valve for hot and cold water)
Vapor Car Heating Co., Inc., Chicago, Ill.

VALVES, MOTOR OPERATED

●Au-Temp-Co Corp., New York, N. Y.
Automatic Temperature Control Co., Inc., Philadelphia, Pa.
●Barber-Colman Co., Rockford, Ill.
●Bell & Gossett Co., Chicago, Ill.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Chapman Valve Mfg. Co., The, Indian Orchard, Mass.
Cooper Co., Clark, Philadelphia, Pa.
Crane Co., Chicago, Ill.
Cutler-Hammer, Inc., Milwaukee, Wis.
Darling Valve & Mfg. Co., Williamsport, Pa.
Davis Regulator Co., Chicago, Ill.
Eddy Valve Co., Waterford, N. Y.
Edward Valve & Mfg. Co., Inc., East Chicago, Ind.

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●Fairbanks Co., New York, N. Y.
Foster Engineering Co., Newark, N. J.
Foxboro Co., Foxboro, Mass.
General Controls Co., Glendale, Cal.
General Electric Co., Schenectady, N. Y.
Hasco Valve & Machine Co., Milwaukee, Wis.
Homestead Valve Mfg. Co., Coraopolis, Pa.
●Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York, N. Y.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Kieley & Mueller, Inc., New York, N. Y.
Klipfel Mfg. Co., Chicago, Ill.
Leslie Co., Lyndhurst, N. J.
Ludlow Valve Mfg. Co., Troy, N. Y.
Lunkenheimer Co., Cincinnati, O.
Mason-Neilan Regulator Co., Boston, Mass.
McAlear Mfg. Co., Chicago, Ill.
Mercoid Corp., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Monat Valve & Forge Co., Inc., Pittsburgh, Pa.
Perfex Corp. (Control Div.), Milwaukee, Wis.
Powell Co., Wm., Cincinnati, O.
R-S Products Corp., Philadelphia, Pa.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Ruggles-Klingemann Mfg. Co., Salem, Mass.
●Sarco Co., Inc., New York, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
Shallcross Controls, Inc., Milwaukee, Wis.
Sterling Engineering Co., Milwaukee, Wis.
Tallmadge & Co., Webster, East Orange, N. J.
Taylor Instrument Companies, Rochester, N. Y.
Trerice Co., H. O., Detroit, Mich.
Vapor Car Heating Co., Inc., Chicago, Ill.
Vogt Machine Co., Henry, Louisville, Ky.
Walworth Co., New York, N. Y.
●Webster & Co., Warren, Camden, N. J.

VALVES, NEEDLE

Chapman Valve Mfg. Co., The, Indian Orchard, Mass.
Crane Co., Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Detroit Brass & Malleable Wks., Detroit, Mich.
●Detroit Lubricator Co., Detroit, Mich.
Edward Valve & Mfg. Co., Inc., East Chicago, Ind.
●Henry Valve Co., Chicago, Ill.
Imperial Brass Mfg. Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Jenkins Bros., New York, N. Y.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Lunkenheimer Co., Cincinnati, O.
●Maid-O-Mist, Inc., Chicago, Ill.
Manning, Maxwell & Moore, Inc., Hancock Valve Div., Bridgeport, Conn.
Milwaukee Valve Co., Milwaukee, Wis.
Ohio Brass Co., Mansfield, O.
Ohio Injector Co., Wadsworth, O.
Parker Appliance Co., Cleveland, O.
Powell Co., Wm., Cincinnati, O.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Shank Co., Cyrus, Chicago, Ill.
Walworth Co., New York, N. Y.
Williams Valve Co., D. T., Cincinnati, O.

VALVES, PLUG

Barrett, Haentjens & Co., Hazleton, Pa.
Barrett Machine Co., N. S., Pittsburgh, Pa.
Bordo Co., Inc., L. J., Glenside, Pa.
Central Valve Mfg. Co., Chicago, Ill.
Chapman Valve Mfg. Co., The, Indian Orchard, Mass.
Crane Co., Chicago, Ill.
Eddy Valve Co., Waterford, N. Y.
Edward Valve & Mfg. Co., Inc., East Chicago, Ind.
Everlasting Valve Co., Jersey City, N. J.
●Fairbanks Co., New York, N. Y.
Golden-Anderson Valve Specialty Co., Pittsburgh, Pa.
Hasco Valve & Machine Co., Milwaukee, Wis.
Homestead Valve Mfg. Co., Coraopolis, Pa.
Inner-Tite Clamp Corp., Elizabeth, N. J.
Jenkins Bros., New York, N. Y.
Klingerit, Inc., New York, N. Y.
Lunkenheimer Co., Cincinnati, O.
Luzerne Rubber Co., Trenton, N. J. (Hard rubber)
Merco Nordstrom Valve Co., Pittsburgh, Pa. (Lubricated)
Monat Valve & Forge Co., Inc., Pittsburgh, Pa.
Mueller Co., Decatur, Ill.
Northern Indiana Brass Co., Elkhart, Ind.
Ohio Injector Co., Wadsworth, O.
Parker Appliance Co., Cleveland, O.
Pittsburgh Brass Mfg. Co., Pittsburgh, Pa.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Powell Co., Wm., Cincinnati, O.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.
Stockham Pipe Fittings Co., Birmingham, Ala.
Walworth Co., New York, N. Y.
White Flo-Matic Corp., Hoosick Falls, N. Y.
Williams Valve Co., D. T., Cincinnati, O.

VALVES, PRESSURE REDUCING AND REGULATING

●American District Steam Co., North Tonawanda, N. Y.
American Injector Co., Detroit, Mich.
Atlas Valve Co., Inc., Newark, N. J.
Bailey Meter Co., Cleveland, O.
Belfield Co., H., Philadelphia, Pa.
●Bell & Gossett Co., Chicago, Ill.
Boylston Steam Specialty Co., Chicago, Ill.
●Cash Co., A. W., Decatur, Ill.
Cash Universal Regulator Co., Marshalltown, Ia.
Central Brass Mfg. Co., Cleveland, O.
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
Clees Valve & Engineering Co., New York, N. Y.
Cooper Co., Clark, Philadelphia, Pa.
Crane Co., Chicago, Ill.
Davis Regulator Co., Chicago, Ill.
Defender Automatic Regulator Co., St. Louis, Mo.
d'Este Co., Julian, Charlestown, Mass.
●Dunham Co., C. A., Chicago, Ill.
Eclipse Fuel Engineering Co., Rockford, Ill.
Fisher Governor Co., Marshalltown, Ia.
Foster Engineering Co., Newark, N. J.
Golden-Anderson Valve Specialty Co., Pittsburgh, Pa.
Grove Regulator Co., Oakland, Cal.
Hubbell Corp., Chicago, Ill.
●Illinois Engineering Co., Chicago, Ill.
Keckley Co., O. C., Chicago, Ill.
Kieley & Mueller, Inc., New York, N. Y.
Klipfel Mfg. Co., Chicago, Ill.
Leslie Co., Lyndhurst, N. J.
Locke Regulator Co., Salem, Mass.
Mason-Neilan Regulator Co., Boston, Mass.
McAlear Mfg. Co., Chicago, Ill.
Monmouth Products Co., Cleveland, O.
Mueller Co., Decatur, Ill.
Mueller Steam Specialty Co., Inc., New York, N. Y.
Norgren Co., Inc., C. A., Denver, Colo.
Parker Appliance Co., Cleveland, O.
●Powers Regulator Co., Chicago, Ill.
Republic Flow Meters Co., Chicago, Ill.
Ross Valve Mfg. Co., Inc., Troy, N. Y.
Ruggles-Klingemann Mfg. Co., Salem, Mass.
Schade Valve Mfg. Co., Philadelphia, Pa.
Schutte & Koerting Co., Philadelphia, Pa.
Shallcross Controls, Inc., Milwaukee, Wis.
Spence Engineering Co., Inc., Walden, N. Y.
Squires Co., C. E., Cleveland, O.
Staples & Pfeiffer, Ltd., San Francisco, Cal.
Sterling Engineering Co., Milwaukee, Wis.
Stickle Steam Specialties Co., Indianapolis, Ind.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
Swartwout Co., Cleveland, O.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Thrush & Co., H. A., Peru, Ind.
Trerice Co., H. O., Detroit, Mich.
Triplex Mfg. Co., Peru, Ind.
Tryco Products, Inc., Westfield, Mass.
Vapor Car Heating Co., Inc., Chicago, Ill.
Watson & McDaniel Co., Philadelphia, Pa.
Watts Regulator Co., Lawrence, Mass.
●Webster & Co., Warren, Camden, N. J.
White Flo-Matic Corp., Hoosick Falls, N. Y.

VALVES, RADIATOR, AIR

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Anderson Products, Inc., Cambridge, Mass.
●Au-Temp-Co Corp., New York, N. Y.
Beaton & Cadwell Mfg. Co., New Britain, Conn.
Beaton & Corbin Mfg. Co., Southington, Conn.
●Burnham Boiler Corp., Irvington, N. Y.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Chicago Specialty Mfg. Co., Chicago, Ill.
Crane Co., Chicago, Ill.
●Detroit Lubricator Co., Detroit, Mich.
●Dole Valve Co., Chicago, Ill.
Gorton Heating Corp., Cranford, N. J.
Hoffman Specialty Co., Inc., Waterbury, Conn.
Jarecki Mfg. Co., Erie, Pa.
Jenkins Bros., New York, N. Y.
Keeney Mfg. Co., Newington, Conn.
Little Mfg. Co., M. S., Hartford, Conn.
Logan Electric Specialty Mfg. Co., Chicago, Ill.
●Maid-O-Mist, Inc., Chicago, Ill. (Humidifying)
Marsh Corp., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Monash-Younker Co., Chicago, Ill.
Murdock Mfg. & Supply Co., Cincinnati, O.
National Metal Products Corp., Chicago, Ill.
New York Air Valve Corp., New York, N. Y.
Ohio Brass Co., Mansfield, O.
Russell & Co., W. A., Bridgeport, Conn.
Scovill Mfg. Co., Waterville Div., Waterville, Conn.
Slater Mfg. Co., Wakefield, Mass.
Sullivan Valve & Engineering Co., Butte, Mont.
Vapor Specialty Co., New York, N. Y.

VALVES, RADIATOR, AUTOMATIC TEMPERATURE CONTROL, ELECTRIC

●Au-Temp-Co Corp., New York, N. Y.
●Barber-Colman Co., Rockford, Ill.
Electric Valve Mfg. Co., Inc., New York, N. Y.
●Fulton Sylphon Co., Knoxville, Tenn.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
●Sarco Co., Inc., New York, N. Y.
Vapor Car Heating Co., Inc., Chicago, Ill.

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VALVES, RADIATOR, AUTOMATIC TEMPERATURE CONTROL, PNEUMATIC

●Johnson Service Co., Milwaukee, Wis.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenburg Instrument Div., Bridgeport, Conn.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
●Powers Regulator Co., Chicago, Ill.

VALVES, RADIATOR, AUTOMATIC TEMPERATURE CONTROL, SELF-CONTAINED

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
●Au-Temp-Co Corp., New York, N. Y.
Clees Valve & Engineering Co., New York, N. Y.
Edison, Inc., Thos. A., Edison Electrical Controls Div., West Orange, N. J.
●Fulton Sylphon Co., Knoxville, Tenn.
Lawler Automatic Controls, Inc., Mount Vernon, N. Y.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., Bridgeport, Conn.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
●Powers Regulator Co., Chicago, Ill.
Sterling Engineering Co., Milwaukee, Wis.
Tallmadge & Co., Webster, East Orange, N. J.
●Trane Co., La Crosse, Wis.

VALVES, RADIATOR, ORIFICE

●American District Steam Co., North Tonawanda, N. Y.
Barnes & Jones, Inc., Boston, Mass.
●Bell & Gossett Co., Chicago, Ill.
●Detroit Lubricator Co., Detroit, Mich.
●Dunham Co., C. A., Chicago, Ill.
●Grinnell Co., Inc., Providence, R. I.
Haines & Co., William S., Philadelphia, Pa.
Hoffman Specialty Co., Inc., Waterbury, Conn.
●Illinois Engineering Co., Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
New York Air Valve Corp., New York, N. Y.
●Sarco Co., Inc., New York, N. Y.
●Trane Co., La Crosse, Wis.
Walker & Eder, New York, N. Y.
●Webster & Co., Warren, Camden, N. J.

VALVES, RADIATOR, STEAM AND HOT WATER, HAND

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Belfield Co., H., Philadelphia, Pa.
Belknap Mfg. Co., Bridgeport, Conn.
●Bishop & Babcock Mfg. Co., Cleveland, O.
●Burnham Boiler Corp., Irvington, N. Y.
Capitol Brass Div., Bohn Aluminum & Brass Corp., Detroit, Mich.
Commonwealth Brass Corp., Detroit, Mich.
Crane Co., Chicago, Ill.
Detroit Brass & Malleable Wks., Detroit, Mich.
●Detroit Lubricator Co., Detroit, Mich.
●Dunham Co., C. A., Chicago, Ill.
●Fairbanks Co., New York, N. Y.
Gorton Heating Corp.. Cranford, N. J.
●Grinnell Co., Inc., Providence, R. I.
Haines & Co., William S., Philadelphia, Pa.
Hammond Brass Wks., Hammond, Ind.
Hoffman Specialty Co., Waterbury, Conn.
●Illinois Engineering Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
Jenkins Bros., New York, N. Y.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Lunkenheimer Co., Cincinnati, O.
Marsh Corp., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Monash-Younker Co., Chicago, Ill.
Ohio Brass Co., Mansfield, O.
Ohio Injector Co., Wadsworth, O.
Ohio Pattern Wks. & Fdry. Co., Eureka Valve Div., Cincinnati, O.
Pierce, Butler Radiator Corp., Syracuse, N. Y.
Powell Co., Wm., Cincinnati, O.
Rockford Brass Works, Rockford, Ill.
●Sarco Co., Inc., New York, N. Y.
Sterling Engineering Co., Milwaukee, Wis.
Stickle Steam Specialities Co., Indianapolis, Ind.
●Trane Co., La Crosse, Wis.
Walworth Co., New York, N. Y.
●Webster & Co., Warren, Camden, N. J.
Williams Valve Co., D. T., Cincinnati, O.

VALVES, RADIATOR, STEAM AND HOT WATER, MODULATING

●American District Steam Co., North Tonawanda, N. Y.
American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Barnes & Jones, Inc., Boston, Mass.
Belknap Mfg. Co., Bridgeport, Conn.
●Bishop & Babcock Mfg. Co., Cleveland, O.
Capitol Brass Div., Bohn Aluminum & Brass Corp., Detroit, Mich.
Cashin Co., W. D., Boston, Mass.
Commonwealth Brass Corp., Detroit, Mich.
Crane Co., Chicago, Ill.
Cryer Trap & Valve Co., Inc., New York, N. Y.
●Detroit Lubricator Co., Detroit, Mich.
●Dunham Co., C. A., Chicago, Ill.
●Fulton Sylphon Co., Knoxville, Tenn.
Gorton Heating Corp., Cranford, N. J.
Haines & Co., William S., Philadelphia, Pa.
Hoffman Specialty Co., Inc., Waterbury, Conn.
●Illinois Engineering Co., Chicago, Ill.
Marsh Corp., Jas. P., Chicago, Ill.
Marsh Valve Co., Dunkirk, N. Y.
McAlear Mfg. Co., Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Monash-Younker Co., Chicago, Ill.
Mouat Vapor Heating Co., The, Cleveland, O.
Ohio Brass Co., Mansfield, O.
Ohio Pattern Wks. & Fdry. Co., Eureka Valve Div., Cincinnati, O.
Pierce, Butler Radiator Corp., Syracuse, N. Y.
●Sarco Co., Inc., New York, N. Y.
Simplex Heating Specialty Co., Inc., Lynchburg, Va.
Sterling Engineering Co., Milwaukee, Wis.
Tallmadge & Co.. Webster, East Orange, N. J.
●Trane Co., La Crosse, Wis.
Vapor Specialty Co., New York, N. Y.
●Webster & Co., Warren, Camden, N. J.

VALVES, REFRIGERATION (ANGLE, CHECK, GATE, GLOBE, NEEDLE, RELIEF)

Ashton Valve Co., Cambridge, Mass.
●Baker Ice Machine Co., Inc., Omaha, Neb.
Belknap Mfg. Co., Bridgeport, Conn.
Crane Co., Chicago, Ill.
●Henry Valve Co., Chicago, Ill.
Imperial Brass Mfg. Co., Chicago, Ill.
Kerotest Mfg. Co., Pittsburgh, Pa.
Monat Valve & Forge Co., Inc., Pittsburgh, Pa.
●Mueller Brass Co., Port Huron, Mich.
Parker Appliance Co., Cleveland, O.
Peerless of America, Inc., Chicago, Ill.
Perfection Refrigeration Parts Co., Harvey, Ill.
Pierce, Butler Radiator Corp., Syracuse, N. Y.
Shank Co., Cyrus, Chicago, Ill.
Superior Valve and Fittings Co., Pittsburgh, Pa.
Triumph Ice Machine Co., Cincinnati, O.
●Vilter Mfg. Co., Milwaukee, Wis.
Vogt Machine Co., Henry, Louisville, Ky.
Voss, Inc., J. H. H., New York, N. Y.
Walworth Co., New York, N. Y.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
X L Refrigerating Co., Chicago, Ill.
●York Ice Machinery Corp., York, Pa.

VALVES, REFRIGERATION, BACK PRESSURE

●Baker Ice Machine Co., Inc., Omaha, Neb.
Burrows Mfg. Co., F. A., York, Pa.
●Cash Co., A. W., Decatur, Ill.
Cash Universal Regulator Co., Marshalltown. Ia.
Electrimatic Corp., Chicago, Ill.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.
Foster Engineering Co., Newark, N. J.
Hubbell Corp., Chicago, Ill.
Imperial Brass Mfg. Co., Chicago, Ill.
●Mueller Brass Co., Port Huron, Mich.
X L Refrigerating Co., Chicago, Ill.
●York Ice Machinery Corp., York, Pa.

VALVES, REFRIGERATION, EXPANSION, CONSTANT PRESSURE

●Alco Valve Co., St. Louis, Mo.
American Injector Co., Detroit, Mich.
●Automatic Products Co., Milwaukee, Wis.
●Baker Ice Machine Co., Inc., Omaha, Neb.
●Cash Co., A. W., Decatur, Ill.
Cash Universal Regulator Co., Marshalltown. Ia.
●Detroit Lubricator Co., Detroit, Mich.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.
Foster Engineering Co., Newark, N. J.
●Fulton Sylphon Co., Knoxville, Tenn.
Hubbell Corp., Chicago, Ill.
Manning, Maxwell & Moore Inc., Consolidated Safety Valve Div., Bridgeport, Conn.
●Mueller Brass Co., Port Huron, Mich.
Peerless of America, Inc., Chicago, Ill.
Perfection Refrigeration Parts Co., Harvey, Ill.
Triumph Ice Machine Co., Cincinnati, O.
X L Refrigerating Co., Chicago, Ill.

VALVES, REFRIGERATION, EXPANSION, THERMOSTATIC

●Alco Valve Co., St. Louis, Mo.
American Injector Co., Detroit, Mich.
●Automatic Products Co., Milwaukee, Wis.
●Detroit Lubricator Co., Detroit, Mich.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.
Larkin Coils, Inc., Atlanta, Ga.
Mayson Mfg. Co., Inc., Detroit, Mich.

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●Mueller Brass Co., Port Huron, Mich.
Peerless of America, Inc., Chicago, Ill.
Perfection Refrigeration Parts Co., Harvey, Ill.
●Spoehrer-Lange Co., St. Louis, Mo.
Torrey Refrigeration Products, Los Angeles, Cal.
Voss Co., J. H. H., New York, N. Y.
X L Refrigerating Co., Chicago, Ill.

VALVES, REFRIGERATION, FLOAT, HIGH PRESSURE

●Alco Valve Co., St. Louis, Mo.
American Injector Co., Detroit, Mich.
●Fedders Mfg. Co., Inc., Buffalo, N. Y.
Foster Engineering Co., Newark, N. J.
●Frick Co., Waynesboro, Pa.
Hubbell Corp., Chicago, Ill.
Imperial Brass Mfg. Co., Chicago, Ill.
Mercoid Corp., Chicago, Ill.
●Mueller Brass Co., Port Huron, Mich.
Perfection Refrigeration Parts Co., Harvey, Ill.
Strong, Carlisle & Hammond Co., The, Cleveland, O.
●Vilter Mfg. Co., Milwaukee, Wis.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
X L Refrigerating Co., Chicago, Ill.
●York Ice Machinery Corp., York, Pa.

VALVES, REFRIGERATION, MAGNETIC STOP

●Alco Valve Co., St. Louis, Mo.
●Automatic Products Co., Milwaukee, Wis.
Automatic Switch Co., New York, N. Y.
●Detroit Lubricator Co., Detroit, Mich.
Electric Valve Mfg. Co., Inc., New York, N. Y.
Electrimatic Corp., Chicago, Ill.
●Frick Co., Waynesboro, Pa.
General Controls Co., Glendale, Cal.
Hubbell Corp., Chicago, Ill.
Mercoid Corp., Chicago, Ill.
Penn Electric Switch Co., Goshen, Ind.
X L Refrigerating Co., Chicago, Ill.

VALVES, REFRIGERATION, WATER REGULATING, PRESSURE OR TEMPERATURE ACTUATED

●Automatic Products Co., Milwaukee, Wis.
●Cash Co., A. W., Decatur, Ill.
d'Este Co., Julian, Charlestown, Mass.
Electrimatic Corp., Chicago, Ill.
Foster Engineering Co., Newark, N. J.
Mercoid Corp., Chicago, Ill.
Mueller Co., Decatur, Ill.
●Mueller Brass Co., Port Huron, Mich.
Penn Electric Switch Co., Goshen, Ind.
Perfection Refrigeration Parts Co., Harvey, Ill.
●Sarco Co., Inc., New York, N. Y.
Shank Co., Cyrus, Chicago, Ill.
Spence Engineering Co., Inc., Walden, N. Y.
Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.

VALVES, RELIEF

Ashton Valve Co., Cambridge, Mass.
Beaton & Cadwell Mfg. Co., New Britain, Conn.
Boyiston Steam Specialty Co., Chicago, Ill.
●Cash Co., A. W., Decatur, Ill.
Cash Universal Regulator Co., Marshalltown, Ia.
Chaplin-Fulton Mfg. Co., Pittsburgh, Pa.
Crane Co., Chicago, Ill.
Davis Regulator Co., Chicago, Ill.
d'Este Co., Julian, Charlestown, Mass.
●Detroit Lubricator Co., Detroit, Mich.
Eddy Valve Co., Waterford, N. Y.
Edward Valve & Mfg. Co., Inc., East Chicago, Ind.
Fisher Governor Co., Marshalltown, Ia.
Foster Engineering Co., Newark, N. J.
Fulflo Specialties Co., Inc., The, Blanchester, O. (Oil)
Golden-Anderson Valve Specialty Co., Pittsburgh, Pa.
●Henry Valve Co., Chicago, Ill.
●Illinois Engineering Co., Chicago, Ill.
Kieley & Mueller, Inc., New York, N. Y.
Klipfel Mfg. Co., Chicago, Ill.
Locke Regulator Co., Salem, Mass.
Lonergan Co., J. E., Philadelphia, Pa.
Lunkenheimer Co., Cincinnati, O.
●Maid-O-Mist, Inc., Chicago, Ill.
Marsh Corp., Jas. P., Chicago, Ill.
Mason-Neilan Regulator Co., Boston, Mass.
McAlear Mfg. Co., Chicago, Ill.
Milwaukee Valve Co., Milwaukee, Wis.
Monarch Mfg. Wks., Inc., Philadelphia, Pa.
Mueller Co., Decatur, Ill.
●Mueller Brass Co., Port Huron, Mich.
Mueller Steam Specialty Co., Inc., New York, N. Y.
Norgren Co., Inc., C. A., Denver, Colo.
Parker Appliance Co., Cleveland, O.
Penberthy Injector Co., Detroit, Mich.
Powell Co., Wm., Cincinnati, O.
Ross Valve Mfg. Co., Inc., Troy, N. Y.
Ruggles-Klingemann Mfg. Co., Salem, Mass.
Schade Valve Mfg. Co., Philadelphia, Pa.
Spencer Thermostat Co., Attleboro, Mass.
Staples & Pfeiffer, Ltd., San Francisco, Cal.
Sterling Engineering Co., Milwaukee, Wis.
Swartwout Co., Cleveland, O.
Thrush & Co., H. A., Peru, Ind.
Triplex Mfg. Co., Peru, Ind.
Tryco Products, Inc., Westfield, Mass.
Watson & McDaniel Co., Philadelphia, Pa.
●Watson-Stillman Co., Roselle, N. J.
Watts Regulator Co., Lawrence, Mass.
Wheeler Mfg. Co., C. H., Philadelphia, Pa.
X L Refrigerating Co., Chicago, Ill.

VALVES, SOLDER JOINT

●American Brass Co., Waterbury, Conn.
American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Chase Brass & Copper Co., Inc., Waterbury, Conn.
Crane Co., Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Jenkins Bros., New York, N. Y.
●Mueller Brass Co., Port Huron, Mich.
Northern Indiana Brass Co., Elkhart, Ind.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Powell Co., Wm., Cincinnati, O.
●Streamline Pipe & Fittings Div., Mueller Brass Co., Port Huron, Mich.
Walworth Co., New York, N. Y. (Brazed)
Williams Valve Co., D. T., Cincinnati, O.

VALVES, SOLENOID

●Alco Valve Co., St. Louis, Mo.
Anderson Products, Inc., Cambridge, Mass.
●Au-Temp-Co Corp., New York, N. Y.
●Automatic Products Co., Milwaukee, Wis.
Automatic Switch Co., New York, N. Y.
●Barber-Colman Co., Rockford, Ill.
Belfield Co., H., Philadelphia, Pa.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Cooper Co., Clark, Philadelphia, Pa.
Cutler-Hammer, Inc., Milwaukee, Wis.
Davis Regulator Co., Chicago, Ill.
●Detroit Lubricator Co., Detroit, Mich.
Electric Valve Mfg. Co., Inc., New York, N. Y.
Electrimatic Corp., Chicago, Ill.
Friez & Sons, Julien P., Baltimore, Md.
General Controls Co., Glendale, Cal.
General Electric Co., Schenectady, N. Y.
Golden-Anderson Valve Specialty Co., Pittsburgh, Pa.
Guardian Electric Mfg. Co., Chicago, Ill.
Hammett Mfg. Co., Kansas City, Mo.
Hubbell Corp., Chicago, Ill.
Hunt & Son, C. B., Salem, O.
McDonnell & Miller, Chicago, Ill.
Mercoid Corp., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Parker Appliance Co., Cleveland, O.
Penn Electric Switch Co., Goshen, Ind.
Perfex Corp. (Controls Div.), Milwaukee, Wis.
Pfening Co., Fred D., Columbus, O.
R-S Products Corp., Philadelphia, Pa.
Rega Mfg. Co., Rochester, N. Y.
Ruggles-Klingemann Mfg. Co., Salem, Mass.
●Spoehrer-Lange Co., St. Louis, Mo.
Supreme Electric Products Corp., Rochester, N. Y.
Wheelco Instruments Co., Chicago, Ill.

VALVES, 2, 3, AND 4 WAY

●American Brass Co., Waterbury, Conn.
●Barber-Colman Co., Rockford, Ill.
Belfield Co., H., Philadelphia, Pa.
Bordo Co., Inc., Glenside, Pa.
Bristol Co., Waterbury, Conn.
●Cash Co., A. W., Decatur, Ill.
Crane Co., Chicago, Ill.
Davis Regulator Co., Chicago, Ill.
●Detroit Lubricator Co., Detroit, Mich.
General Controls Co., Glendale, Cal.
Golden-Anderson Valve Specialty Co., Pittsburgh, Pa.
Homestead Valve Mfg. Co., Coraopolis, Pa.
Imperial Brass Mfg. Co., Chicago, Ill.
Inland Mfg. Co., Chicago, Ill.
Jarecki Mfg. Co., Erie, Pa.
●Johnson Service Co., Milwaukee, Wis.
Kerotest Mfg. Co., Pittsburgh, Pa.
Lunkenheimer Co., Cincinnati, O.
Luzerne Rubber Co., Trenton, N. J. (Hard rubber)
Merco Nordstrom Valve Co., Pittsburgh, Pa.
Mercoid Corp., Chicago, Ill.
●Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
●Mueller Brass Co., Port Huron, Mich.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Parker Appliance Co., Cleveland, O.
Penn Electric Switch Co., Goshen, Ind.
Powell Co., Wm., Cincinnati, O.
●Powers Regulator Co., Chicago, Ill.
Ruggles-Klingemann Mfg. Co., Salem, Mass.
Smolensky Valve Co., Inc., Cleveland, O.

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Spence Engineering Co., Inc., Walden, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Walworth Co., New York, N. Y. (Lubricated plug valves)
Weatherhead Co., Cleveland, O.
Williams Valve Co., D. T., Cincinnati, O.

VANES, DUCT TURNING, PREFABRICATED

●Barber-Colman Co., Rockford, Ill.
●Tuttle & Bailey, Inc., New Britain, Conn.
●Waterloo Register Co., Waterloo, Ia.

VAPOR HEATING SYSTEMS

See Systems, Heating, Vapor

V-BELT DRIVES

See Drives, V-Belt

VELOCITY REGULATORS

See Regulators, Air Velocity

VENTILATORS, MUSHROOM

Aeolus Dickinson Co., Chicago, Ill.
Best Register Co., Milwaukee, Wis.
Falstrom Co., Passaic, N. J.
Industrial Sheet Metal Works, Inc., Detroit, Mich.
Knowles Mushroom Ventilator Co., Montclair, N. J.
Mueller Furnace Co., L. J., Milwaukee, Wis.
●Tuttle & Bailey, Inc., New Britain, Conn.
Ventilating Products Co., Chicago, Ill.

VENTILATORS, ROOF, FAN

Aeolus Dickinson Co., Chicago, Ill.
●Air Controls, Inc., Cleveland, O.
Airmaster Corp., Chicago, Ill.
Allen Corp., Detroit, Mich.
American-Larson Ventilating Co., Pittsburgh, Pa.
Arex Co., Chicago, Ill.
●Autovent Fan & Blower Co., Chicago, Ill.
Belanger Fan & Blower Co., Detroit, Mich.
Burt Mfg. Co., Akron, O.
California Cornice, Steel & Supply Corp., Los Angeles, Cal.
Century Fan & Ventilator Co., New York, N. Y.
Chelsea Fan & Blower Co., New York, N. Y.
Clay Equipment Corp., Cedar Falls, Ia.
Davidson Hy Duty Roof Fan Co., Newton, Mass.
De Bothezat Ventilating Equipment Div., American Machine & Metals, Inc., New York, N. Y.
Economy Electric Mfg. Co., Chicago, Ill.
Electrovent Fan & Mfg. Co., Chicago, Ill.
Falstrom Co., Passaic, N. J.
Fingles, Inc., W. A., Baltimore, Md.
General Regulator Corp., Chicago, Ill.
Goethel Co., Alfred C., Milwaukee, Wis.
Grand Rapids Blow Pipe & Dust Arrester Corp., Grand Rapids, Mich.
Hirschman Co., W. F., Buffalo, N. Y.
Howes Co., S. M., Boston, Mass.
Ilg Electric Ventilating Co., Chicago, Ill.
Industrial Sheet Metal Wks., Inc., Detroit, Mich.
International Engineering, Inc., Dayton, O.
Iona Ventilator Co., Inc., Philadelphia, Pa.
Johnson Fan & Blower Corp., Chicago, Ill.
Jordan & Co., Paul R., Indianapolis, Ind.
Kernchen Co., Chicago, Ill.
Lohman, Inc., Wm. J., New York, N. Y.
Myers Electric Co., Pittsburgh, Pa.
Penn Ventilating Co., Philadelphia, Pa.
Propellair, Inc., Springfield, O.
Reed Unit-Fans, Inc., New Orleans, La.
Robertson Co., H. H., Pittsburgh, Pa.
Royal Ventilator Co., Philadelphia, Pa.
●Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Swartwout Co., Cleveland, O.
Trade-Wind Motor Fans, Inc., Los Angeles, Cal.
●U. S. Air Conditioning Corp., Minneapolis, Minn.
Uno Ventilator Co., Cliftondale, Mass.
Utility Fan Corp., Los Angeles, Cal.
Viking Air Conditioning Corp., Cleveland, O.
Washburne & Co., E. G., New York, N. Y.
Western Engineering & Mfg. Co., Los Angeles, Cal.
●Wing Mfg. Co., L. J., New York, N. Y.

VENTILATORS, ROOF, GRAVITY

Accurate Mfg. Works, Chicago, Ill.
Aeolus Dickinson Co., Chicago, Ill.
●Airtherm Mfg. Co., St. Louis, Mo.
Allen Corp., Detroit, Mich.
American Foundry & Furnace Co., Bloomington, Ill.
American-Larson Ventilating Co., Pittsburgh, Pa.
American Sheet Metal Works, New Orleans, La.
Ames Co., W. R., San Francisco, Cal.
Anderson Mfg. Co., Des Moines, Ia.
Arex Co., Chicago, Ill.
Autoforce Ventilating System, Boston, Mass.
Berger Bros. Co., Philadelphia, Pa.
Burt Mfg. Co., Akron, O.
California Cornice, Steel & Supply Corp., Los Angeles, Cal.
Century Fan & Ventilating Co., New York, N. Y.
Chicago Metal Mfg. Co., Chicago, Ill.
Cincinnati Sheet Metal & Roofing Co., Cincinnati, O.
Clay Equipment Corp., Cedar Falls, Ia.
Day Co., The, Minneapolis, Minn.
Edwards Mfg. Co., Inc., Cincinnati, O.
Falstrom Co., Passaic, N. J.
Fingles, Inc., W. A., Baltimore, Md.
Goethel Co., Alfred C., Milwaukee, Wis.
Grand Rapids Blow Pipe & Dust Arrester Co., Grand Rapids, Mich.
Hirschmann Co., W. F., Buffalo, N. Y.
Howes Co., S. M., Charlestown, Boston, Mass.
Hudson Equipment Corp., Minneapolis, Minn.
Industrial Sheet Metal Works, Inc., Detroit, Mich.
International Steel Co., Evansville, Ind.
Iona Ventilator Co., Inc., Philadelphia, Pa.
Iwan Brothers, South Bend, Ind.
Jamar Co., Walker, Duluth, Minn.
Jordan & Co., Paul R., Indianapolis, Ind.
Kernchen Co., Chicago, Ill.
King Ventilating Co., Owatonna, Minn.
Kleenaire Corp., Stevens Point, Wis.
La Crosse Steel Roofing & Corrugating Co., La Crosse, Wis.
Lamneck Products, Inc., Columbus, O.
Lee & Son Co., Thomas, Cincinnati, O.
Levow, David, New York, N. Y.
Martin Metal Mfg. Co., Wichita, Kans.
Mellish & Murray Co., Chicago, Ill.
Merchant & Evans Co., Philadelphia, Pa.
Meyer & Bro. Co., F., Peoria, Ill.
Milcor Steel Co., Milwaukee, Wis.
Norman Sheet Metal Mfg. Co., W. F., Nevada, Mo.
Osborn Co., The, J. M. & L. A., Cleveland, O.
Patten Co., J. V., Sycamore, Ill.
Penn Ventilating Co., Philadelphia, Pa.
Pioneer Roofing & Sheet Metal Co., Muskogee, Okla.
Puhl & Hepper Mfg. Co., Inc., St. Louis, Mo.
Robertson Co., H. H., Pittsburgh, Pa.
Royal Ventilator Co., Philadelphia, Pa.
Rynicker Sheet Metal Works, Inc., Billings, Mont.
St. Paul Corrugating Co., St. Paul, Minn.
Schoedinger, F. O., Columbus, O.
Southbridge Roofing Co., Inc., Southbridge, Mass.
Southern States Iron Roofing Co., Savannah, Ga.
Swartwout Co., Cleveland, O.
Tierney Rotor Ventilator Co., Minneapolis, Minn.
Tiffin Art Metal Co., Tiffin, O.
Uno Ventilator Co., Cliftondale, Mass.
Van Noorden Co., E. Boston, Mass.
Western Engineering & Mfg. Co., Los Angeles, Cal.
Willis Mfg. Co., Galesburg, Ill.
York Corrugating Co., York, Pa.

VENTILATORS, UNIT

Johnson Fan & Blower Corp., Chicago, Ill.
Nelson Corp., Herman, Moline, Ill.
●Nesbitt, Inc., John J., & Buckeye Blower Co., Philadelphia, Pa.
New York Blower Co., Chicago, Ill.
Peerless Unit Ventilation Co., Inc., Bridgeport, Conn.
●Sturtevant Co., B. F., Boston, Mass.
●Trane Co., La Crosse, Wis.

VIBRATION ELIMINATORS

See Bases and Pads, Vibration Isolating; Hose, Metal, for Eliminating Compressor Vibration

VIBRATION ISOLATORS

See Bases and Pads, Vibration Isolating; Hose, Metal, for Eliminating Compressor Vibration

VISCOUS LIQUID PUMPS

See Pumps, Viscous Liquids

VISES, PIPE

American Pipe Tool Co., Chicago, Ill.
Armstrong Bros. Tool Co., Chicago, Ill.
Armstrong Mfg. Co., Bridgeport, Conn.
Beaver Pipe Tools, Inc., Warren, O. (Sawing—for tubing)
Billings & Spencer Co., Hartford, Conn.
Crown Die & Tool Co., Chicago, Ill.
Desmond-Stephen Mfg. Co., Urbana, Ill.
Erie Tool Wks., Erie, Pa.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hollands Mfg. Co., Erie, Pa.
International Nutyp Tool Corp., Oswego, N. Y.
Jarecki Mfg. Co., Erie Pa.
Nye Tool & Machine Wks., The, Chicago, Ill.
Ridge Tool Co., Elyria, O.
Toledo Pipe Threading Machine Co., Toledo, O.
Trimont Mfg. Co., Roxbury, Mass.
Vanderman Mfg. Co., Willimantic, Conn.
Walworth Co., New York, N. Y.
●Williams & Co., J. H., New York, N. Y.
Yost Mfg. Co., Meadville, Pa.

VISE STANDS

See Stands, Pipe Vise

WALL THERMOSTATS

See Thermostats, Room or Wall

WARM AIR FURNACES

See Furnaces, Warm Air

WASHERS, AIR

●Air & Refrigeration Corp., New York, N. Y.
American Blower Corp., Detroit, Mich.
American Foundry & Furnace Co., Bloomington, Ill.

Ames Co., W. R., San Francisco, Cal.
Atlas Heating & Ventilating Co., Ltd., San Francisco, Cal.
●Autovent Fan & Blower Co., Chicago, Ill.
Ballantyne Co., Omaha, Neb.
Bayley Blower Co., Milwaukee, Wis.
Belanger Fan & Blower Co., Detroit, Mich.
Betz Air Conditioning Corp., Kansas City, Mo.
●Bishop & Babcock Mfg. Co., Cleveland, O.
Blower Application Co., Milwaukee, Wis.
Brundage Co., Kalamazoo, Mich.
Bubar, Hudson H., New York, N.Y.
●Buffalo Forge Co., Buffalo, N. Y.
●Carrier Corp., Syracuse, N. Y.
●Clarage Fan Co., Kalamazoo, Mich.
Columbus Heating & Ventilating Co., Columbus, O.
Cooling Tower Co., Inc., The, Div. of The Fluor Corp., Ltd., New York, N. Y.
Dail Steel Products Co., Lansing, Mich.
Electrovent Fan & Mfg. Co., Chicago, Ill.
Industrial Sheet Metal Works, Inc., Detroit, Mich.
Kauffman Air Conditioning Corp., St. Louis, Mo.
King Ventilating Co., Owatonna, Minn.
Magirl Foundry & Furnace Wks., P. H., Bloomington, Ill.
Mellish & Murray Co., Chicago, Ill.
Mueller Furnace Co., L. J., Milwaukee, Wis.
New York Blower Co., Chicago, Ill.
Niagara Blower Co., New York, N. Y.
Northern Blower Co., Cleveland, O.
Parks-Cramer Co., Fitchburg, Mass.
Penn Cooling Tower Wks., Pittsburgh, Pa.
Spray Engineering Co., Somerville, Mass.
Strandwitz & Co., Inc., W. J., Camden, N. J.
●Sturtevant Co., B. F., Boston, Mass.
Supreme Heater & Ventilating Corp., St. Louis, Mo.
Todd Air Conditioning Co., Inc., Bonner Springs, Kans.
●Trane Co., La Crosse, Wis.
●U. S. Air Conditioning Corp., Minneapolis, Minn.
Utica Radiator Corp., Utica, N. Y.
Utility Fan Corp., Los Angeles, Cal.
●Vilter Mfg. Co., Milwaukee, Wis.
Western Blower Co., Seattle, Wash.
●York Ice Machinery Corp., York, Pa.

WATER CHILLERS

See Chillers, Water, for Air Conditioning and Refrigeration

WATER HEATERS

See Heaters, Water

WATER METERS

See Meters, Water

WATER TREATMENT

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Hydrozone Co., Inc., New York, N. Y.
Aquatic Chemical Laboratories, Inc., New York, N. Y.
Automatic Pump & Softener Corp., Rockford, Ill.
Bird-Archer Co., New York, N. Y.
Builders Iron Foundry, Providence, R. I.
Continental Products Co., Euclid, O.
Dampney Co. of America, Boston, Mass.
Dearborn Chemical Co., Chicago, Ill.
Elgin Softener Corp., Elgin, Ill.
Ferro-Nil Corp., New York, N. Y.
Filtrine Mfg. Co., Inc., Brooklyn, N. Y.
Grief, Edward C., Bogota, N. J.
Haering Co., D. W., Chicago, Ill.
Hagan Corp., Pittsburgh, Pa.
Metropolitan Refining Co., Long Island City, N. Y.
Mutual Chemical Co. of America, New York, N. Y.
National Aluminate Corp., Chicago, Ill.
Oakite Products, Inc., New York, N. Y.
Permutit Co., New York, N. Y.,
R. U. V. Engineering Corp., New York, N. Y.
Red Jacket Mfg. Co., Davenport, Ia.
Refinite Corp., Omaha, Nebr.
Research Products Corp., Madison, Wis.
Scaife & Sons Co., Wm. B., Oakmont, Pa.
Solvay Sales Corp, New York, N. Y.
Uniflow Mfg. Co., Erie, Pa.
Warlo Corp., New York, N. Y.
Water Refining Co., Ft. Wayne, Ind.

WATER VAPOR REFRIGERATION

See Compressors, Refrigerating, Centrifugal; and Compressors, Refrigerating, Steam Jet

WELDERS, ARC

Adams Mfg. Co., J. D., Indianapolis, Ind.
Alter-Arc Mfg. Co., Lawton, Okla.
Burke Electric Co., Erie, Pa.
Commonwealth Mfg. Corp., Cincinnati, O.
Eisler Engineering Corp., Newark, N. J.
Electric Arc Cutting & Welding Co., Newark, N. J.
Emerson Electric Mfg. Co., St. Louis, Mo.
General Electric Co., Schenectady, N. Y.
General Equipment Co., Wichita, Kan.
Giant Grip Mfg. Co., Oshkosh, Wis.
Hammett Mfg. Co., Kansas City, Mo.
Hampton Electric Tool Co., Pittsburgh, Pa.
Harnischfeger Corp., Milwaukee, Wis.
Hobart Bros., Troy, O.
Hollup Corp., Chicago, Ill.
Ideal Electric & Mfg. Co., Mansfield, O.
Imperial Electric Co., Akron, O.
Lee & Son Co., K. O., Aberdeen, S. D.
Lincoln Electric Co., Cleveland, O.
Maple Valley Mfg. Co., Mapleton, Ia.
Marquette Mfg. Co., Minneapolis, Minn.
Master Welders, Kansas City, Mo.
Miller Electric Mfg. Co., Appleton, Wis.
Ohio Welder Co., Middlefield, O.
Owen-Dyneto Corp., Syracuse, N. Y.
Pier Equipment Mfg. Co., Benton Harbor, Mich.
Sight Feed Generator Co., Richmond, Ind.
Smith Welding Equipment Co., Minneapolis, Minn.
Star Electric Motor Co., Bloomfield, N. J.
Trindl, Inc., Jos. H., Chicago, Ill.
Una Welding, Inc., Cleveland, O.
Universal Power Corp., Cleveland, O.
Weldex, Inc., Detroit, Mich.
Welding Apparatus Co., Chicago, Ill.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Will-Weld Mfg. Co., Inc., Omaha, Neb.
Wilson Welder & Metals Co., Inc., New York, N. Y.

WELDERS, SPOT

Acme Electric Welder Co., Huntington Park, Cal.
Agnew Electric Welder Co., Milford, Mich.
Commonwealth Mfg. Corp., Cincinnati, O.
Eisler Engineering Corp., Newark, N. J.
Electric Arc Cutting & Welding Co., Newark, N. J.
Federal Machine & Welder Co., Warren, O.
General Electric Co., Schenectady, N. Y.
Giant Grip Mfg. Co., Oshkosh, Wis.
Hammett Mfg. Co., Kansas City, Mo.
Micro Products Co., Chicago, Ill.
Miller Electric Mfg. Co., Appleton, Wis.
Pier Equipment Mfg. Co., Benton Harbor, Mich.
Taylor-Hall Welding Corp., Worcester, Mass.
Taylor-Winfield Corp., Warren, O.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Universal Power Corp., Cleveland, O.
Weldex, Inc., Detroit, Mich.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

WELDING AND CUTTING APPARATUS, OXY-ACETYLENE

Air Reduction Sales Co., New York, N. Y.
Bastian-Blessing Co., Chicago, Ill.
Burdett Mfg. Co., Chicago, Ill.
Carbo-Oxygen Co., Pittsburgh, Pa.
Dockson Co., C. H., Detroit, Mich.
Gasweld Equipment Co., Chicago, Ill.
Harris Calorific Co., The, Cleveland, O.
Imperial Brass Mfg. Co., Chicago, Ill.
Insto-Gas Corp., Detroit, Mich.
Linde Air Products Co., The, Unit of Union Carbide & Carbon Corp., New York, N. Y.
Milburn Co., Alexander, Baltimore, Md.
Modern Engineering Co., St. Louis, Mo.
Sight Feed Generator Co., Richmond, Ind.
Smith Welding Equipment Co., Minneapolis, Minn.
Torchweld Equipment Co., Div. of National Cylinder Gas Co., Chicago, Ill.

WELDING FUME COLLECTORS

See Collectors, Welding Fume

WELDING ROD

See Rod, Gas Welding

WELDING PIPE CLAMPS

See Clamps, Pipe, Welding

WHEELS, BLOWER

Advance Alumnium Castings Corp., Chicago, Ill.
●Air Controls, Inc., Cleveland, O.
American Blower Corp., Detroit, Mich.
●Autovent Fan & Blower Co., Chicago, Ill.
Bayley Blower Co., Milwaukee, Wis.
●Bishop & Babcock Mfg. Co., Cleveland, O.
●Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.
●Clarage Fan Co., Kalamazoo, Mich.
Economy Electric Mfg. Co., Chicago, Ill.
Furbio Co., Hermansville, Mich.
Hastings Air Conditioning Co., Hastings, Neb.
Jaden Mfg. Co., Inc., F., Hastings, Neb.
Janette Mfg. Co., Chicago, Ill.
Lau Blower Co., Dayton, O.
New York Blower Co., Chicago, Ill.
Palmer's Mfg. Corp., Phoenix, Ariz.
Peerless Electric Co., Warren, O.
Schwitzer-Cummins Co., Indianapolis, Ind.
●Sturtevant Co., B. F., Boston, Mass.
●Torrington Mfg. Co., Torrington, Conn.
●U. S. Air Conditioning Corp., Minneapolis, Minn.
Utility Fan Corp., Los Angeles, Cal.
Viking Air Conditioning Corp., Cleveland, O.
Western Blower Co., Seattle, Wash.

● Advertisement in this issue. See Index to Advertisers, page 208.

WINDOW VENTILATOR AND FILTER UNITS

See Units, Window Ventilator and Filter

WINDOWS, HEAT INSULATING

Advance Insulating Co., Pittsburgh, Pa.
Chamberlin Metal Weather Strip Co., Detroit, Mich.
Detroit Steel Products Co., Detroit, Mich.
Libbey-Owens Ford Glass Co., Toledo, O.
Russell Co., F. C., Cleveland, O.
Truscon Steel Co., Youngstown, O.

WOOD PIPE

See Pipe, Wood

WRENCHES, ADJUSTABLE

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Bonney Forge & Tool Works, Allentown, Pa.
Crescent Tool Co., Jamestown, N. Y.
Erie Tool Works, Erie, Pa.
Peck, Stow & Wilcox Co., Southington, Conn.
Snap-On Tools Corp., Kenosha, Wis.
Trimont Mfg. Co., Boston, Mass.
● Williams & Co., J. H., New York, N. Y.

WRENCHES, OPEN END

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Blackhawk Mfg. Co., Milwaukee, Wis.
Bonney Forge & Tool Works, Allentown, Pa.
Snap-On Tools Corp., Kenosha, Wis.
● Williams & Co., J. H., New York, N. Y.

WRENCHES, PIPE

Armstrong Bros. Tool Co., Chicago, Ill.
Bernz Co., Inc., Otto, Rochester, N. Y.
Billings & Spencer Co., Hartford, Conn.
Bonney Forge & Tool Works, Allentown, Pa.
Erie Tool Works, Erie, Pa.
Greene, Tweed & Co., New York, N. Y.
Greenfield Tap & Die Corp., Greenfield, Mass.
International Nutyp Tool Corp., Oswego, N. Y.
Ridge Tool Co., Elyria, O.
Trimont Mfg. Co., Boston, Mass.
U. S. Hame Co., Buffalo, N. Y.
Walworth Co., New York, N. Y.

WRENCHES, RATCHET

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Blackhawk Mfg. Co., Milwaukee, Wis.
Bonney Forge & Tool Works, Allentown, Pa.
Greene, Tweed & Co., New York, N. Y.
Lowell Wrench Co., Worcester, Mass.
Snap-On Tools Corp., Kenosha, Wis.
● Williams & Co., J. H., New York, N. Y.

WRENCHES, SOCKET

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Blackhawk Mfg. Co., Milwaukee, Wis.
Bonney Forge & Tool Works, Allentown, Pa.
Lowell Wrench Co., Worcester, Mass.
Snap-On Tools Corp., Kenosha, Wis.
● Williams & Co., J. H., New York, N. Y.

WRENCHES, TORQUE INDICATING

Automotive Maintenance Machinery Co., North Chicago, Ill.
Blackhawk Mfg. Co., Milwaukee, Wis.
Bonney Forge & Tool Works, Allentown, Pa.
Snap-On Tools Corp., Kenosha, Wis.
● Williams & Co., J. H., New York, N. Y.

WROUGHT IRON PIPE

See Pipe, Wrought Iron

WROUGHT IRON SHEETS

See Sheets, Wrought Iron

X-RAY MACHINES AND FILM

See Machines and Film, X-Ray

ZINC SHEETS

See Sheets, Zinc

ZONE CONTROLS

See Systems, Heating, Zone Control

DIRECTORY SECTION

HEATING, PIPING AND AIR CONDITIONING EQUIPMENT FOR INDUSTRY AND LARGE BUILDINGS

PART 2—TRADE NAMES

A-P—Humidistats, damper operators, regulators, strainers, thermostats, valves. Automatic Products Co., Milwaukee, Wis.

ARRC—Fittings. Union Metal Wks., Inc., Chelsea, Mass.

Abrasoweld—Electrodes. Lincoln Electric Co., Cleveland, O.

Absorbex—Insulation. Celotex Corp., The, Chicago, Ill.

Ace—Pipe, pipe and fittings, valves, pumps. American Hard Rubber Co., New York, N. Y.

Acme—Boilers. Titusville Iron Wks. Co., Titusville, Pa.

Acousti-Vent—Insulation. Burgess Battery Co., Chicago, Ill.

Acratherm—Thermostats. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Adjustiblade—Registers. Tuttle & Bailey, Inc., New Britain, Conn.

Adjusto—Packing. Keasbey & Mattison Co., Ambler, Pa.

Adsco—Conduit, heaters, joints, meters, pipe, pipe hangers and supports, separators, strainers, regulators, valves. American District Steam Co., North Tonawanda, N. Y.

Aeracool—Blades, fans, louvers and shutters, ventilators. Myers Electric Co., Pittsburgh, Pa.

Aerisweld—Electrodes. Lincoln Electric Co., Cleveland, O.

Aero-Art—Radiation. National Radiator Co., The, Johnstown, Pa.

Aerocrat—Fans, humidifiers, washers. Ames Co., W. R., San Francisco, Cal.

Aeroplex—Fans. Bayley Blower Co., Milwaukee, Wis.

Aerovalve—Ventilators. Knowles Mushroom Ventilator Co., Montclair, N. J.

Affco—Grilles, louvers and shutters, ventilators. American Foundry & Furnace Co., Bloomington, Ill.

Air-Acoustic—Insulation. Johns-Manville, New York, N. Y.

Airblanket—Unit heaters. Airtherm Mfg. Co., St. Louis, Mo.

Airco—Welding rod. Air Reduction Sales Co., New York, N. Y.

Air-Con—Registers. Register & Grille Mfg. Co., Inc., Brooklyn, N. Y.

Air Control—Bearings, fans, heaters, unit coolers and air conditioners. Hastings Air Conditioning Co., Hastings, Neb.

Airco-DB—Gages, regulators, torches, welding and cutting apparatus. Air Reduction Sales Co., New York, N. Y.

Airefiner—Water treatment. Oakite Products, Inc., New York, N. Y.

Airex—Fans, louvers and shutters. Mountain States Equipment Co., Denver, Colo.

Airfoil—Fans, fan blades. Aerovent Fan Co., Piqua, O.

Airguide—Hygrometers, thermometers. Fee and Stemwedel, Inc., Chicago, Ill.

Airheator—Unit heaters. Airtherm Mfg. Co., St. Louis, Mo.

Airistocrat—Fan blades, fans. Torrington Mfg. Co., Torrington, Conn.

Airline—Grilles, registers. Tuttle & Bailey, Inc., New Britain, Conn.

Airmat Arrester—Dust collectors. American Air Filter Co., Inc., Louisville, Ky.

Airmeter—Hygrometers. Johnson Tool Co., East Providence, R. I.

Airmode—Air conditioning units and window ventilator units. National Standard Air Products Co., Chicago, Ill.

Airofelt—Insulation. Johns-Manville, New York, N. Y.

Air-o-Line—Indicator-controllers, recorder-controllers. Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.

Air-O-Matic—Refrigerating machines. Williams Oil-O-Matic Corp., Bloomington, Ill.

Airotherm—Zone control thermostat. Tallmadge & Co., Webster, East Orange, N. J.

Airplex—Air filters. Davies Air Filter Corp., New York, N. Y.

Airstat—Regulators. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Air Stone—Conduit. Dockstader, S. E., Washington, D. C.

Airswitch—Thermostats. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Air Vane—Grilles, registers. Rock Island Register Co., Rock Island, Ill.

Airstream—Fans. Metal Stamping & Mfg. Co., The, Cleveland, O.

Airvector—Unit heaters. Airtherm Mfg. Co., St. Louis, Mo.

Air-Vent—Fans. Airtherm Mfg. Co., St. Louis, Mo.

Airxpel—Steam traps. Wright-Austin Co., Detroit, Mich.

Akon—Water treatment. Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Alco—Ventilators. Allen Corp., Detroit, Mich.

Alcoa—Angles, electrodes, sheets, tubing. Aluminum Co. of America, Pittsburgh, Pa.

Alkalex—Water treatment. Research Products Corp., Madison, Wis.

Almar—Pittsburgh lock forming machines. Ward Machinery Co., Chicago, Ill.

Alnor—Thermometers, air velocity meters. Illinois Testing Laboratories, Chicago, Ill.

Aloyco—Stainless steel fittings, nipples, pipe, tubing, unions, valves. Alloy Steel Products Co., Linden, N. J.

Aluminweld—Electrodes. Lincoln Electric Co., Cleveland, O.

Always Reliable—Benders, cutters, leak detectors, torches, wrenches. Bernz Co., Inc., Otto, Rochester, N. Y.

Ambler—Cement. Keasbey & Mattison Co., Ambler, Pa.

Ambrac—Welding rod. American Brass Co., Waterbury, Conn.

Ambraloy—Tubing, welding rod. American Brass Co., Waterbury, Conn.

Amco—Humidifiers, humidistats, hygrometers. American Moistening Co., Providence, R. I.

Amco—Packing. Austin-Mason Co., New York, N. Y.

Amirglass—Filters. Amirton Co., New York, N. Y.

Ammco—Wrenches. Automotive Maintenance Machinery Co., North Chicago, Ill.

Anaconda—Fittings, pipe, welding rod, sheets, solder, tubing, valves. American Brass Co., Waterbury, Conn.

Anemo-trol—Air diffusers. Anemostat Corp. of America, New York, N. Y.

Aakorite—Packing. Anchor Packing Co., Philadelphia, Pa.

Anode—Electrodes. Lincoln Electric Co., Cleveland, O.

Anti-Sweat—Insulation. Johns-Manville, New York, N. Y.

Apex—Pipe cutting and threading machines. Merrell Mfg. Co., Toledo, O.

Apex—Quadrants. Ohio Products Co., Cleveland, O.

Apex—Recorders. Uehling Instrument Co., Paterson, N. J.

Apexior—Coatings. Dampney Co. of America, Hyde Park, Boston, Mass.

Aqualator—Circulators. Triplex Mfg. Co., Peru, Ind.

Aquaseal—Cement and compounds. Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.

Aquazone—Humidifiers. Corozone Air Conditioning Corp., Cleveland, O.

Aqulux—Heaters. Johnson Co., S. T., Oakland, Cal.

Arc-Eng—Registers. Register & Grille Mfg. Co., Inc., Brooklyn, N. Y.

Arco—Boilers, eliminators, fittings, hangers, humidifiers, pipe, plates, radiation, regulators, tubing, valves. American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.

Arcoblast—Heating surface. American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.

Arex-Austor—Roof ventilators. Arex Co., Chicago, Ill.

Aridifier—Separators. Logan Engineering Co., Chicago, Ill.

Aristocrat—Registers. Auer Register Co., Cleveland, O.

Armco—Pipe, sheets. American Rolling Mill Co., The, Middletown, O.

Armorak—Insulation. Keasbey Co., Robert A., New York, N. Y.

Arrow—Ventilators. Uno Ventilator Co., Cliftondale, Mass.

Arrowtrol—Registers. Register & Grille Mfg. Co., Inc., Brooklyn, N. Y.

Artic—Refrigerants. du Pont de Nemours & Co., E. I., R. & H. Chemicals Dept., Wilmington, Del.

Asbestocel—Insulation. Johns-Manville, New York, N. Y.

Asco—Valves, relays, switches. Automatic Switch Co., New York, N. Y.

Atlas—Unions. Rockwood Sprinkler Co., Worcester, Mass.

Attievane—Fans. Sturtevant Co., B. F., Hyde Park, Boston, Mass.

Autocrat—Fan blades, fans. Torrington Mfg. Co., Torrington, Conn.

Auto-Klean—Filters, strainers. Cuno Engineering Corp., Meriden, Conn.

Autovent—Eliminators, humidifiers, valves. Maid-O-Mist, Inc., Chicago, Ill.

Autozone—Zone control unit. Tallmadge & Co., Webster, East Orange, N. J.

Axiflo—Propeller fans. Sturtevant Co., B. F., Boston, Mass.

Axiom—Filters. Blocksom & Co., Michigan City, Ind.

B. B.—Electric motors. Brown-Brockmeyer Co., Dayton, O.

BCA—Bearings. Bearings Co. of America, Lancaster, Pa.

B & C—Plates. Beaton & Corbin Mfg. Co., Southington, Conn.

B. & G.—Cement, heaters, relays, regulators, thermostats, valves. Bell & Gossett Co., Chicago, Ill.

B/W—Relays, switches. Bender Warrick Corp., Birmingham, Mich.

B & W—Boilers, burners, tubing, stokers, valves. Babcock & Wilcox Co., New York, N. Y.

Badger—Time switches. Reliance Automatic Lighting Co., Racine, Wis.

Bali-Tank—Water heaters. American Bosch Corp., Springfield, Mass.

Bankheat—Oil burners. Johnson Co., S. T., Oakland, Cal.

Barcol—Humidistats, motors, operators, regulators, thermostats, valves. Barber-Colman Co., Rockford, Ill.

Barnes—Cutters. Erie Tool Works, Erie, Pa.

Battery—Registers. Register & Grille Mfg. Co., Inc., Brooklyn, N. Y.
Beacor—Valves. Beaton & Corbin Mfg. Co., Southington, Conn.
Bell—Cement. Keasbey & Mattison Co., Ambler, Pa.
Belt-Air—Propeller fans. Belco Exhaust Fan Mfg. Co., St. Louis, Mo.
Benco—Oil burners. Bennett Co., Omaha, Neb.
Benton—Boilers. Combination Boiler Co., Benton Harbor, Mich.
Beth-Cu-Loy—Sheets. Bethlehem Steel Co., Bethlehem, Pa.
Bettendorf—Oil burners. Micro-Westco, Inc., Bettendorf, Ia.
Bildrite—Insulation. Insulite Co., Minneapolis, Minn.
Binoc—Thermometers. Taylor Instrument Companies, Rochester, N. Y.
Birm — Water treatment. Research Products Corp., Madison, Wis.
Bison—Boilers. Farrar & Trefts, Buffalo, N. Y.
Bitugloss — Lacquers and enamels. Wailes Dove-Hermiston Corp., New York, N. Y.
Bionpco—Dust collectors. Blower Application Co., Milwaukee, Wis.
Blue Ribbon—Hangers or brackets, nipples, plates. Chicago Nipple Mfg. Co., Chicago, Ill.
Branford—Unions. Malleable Iron Fittings Co., Branford, Conn.
Brazarc—Electrodes. Universal Power Corp., Cleveland, O.
Brazo—Solder. Linde Air Products Co., The, Unit of Union Carbide & Carbon Corp., New York, N. Y.
Breezo—Fans. Buffalo Forge Co., Buffalo, N. Y.
Broomell—Eliminators, floats, heating systems, traps, valves. Vapor Specialty Co., New York, N. Y.
BTUnit—Unit heaters. Industrial Mfg. & Engineering Co., Chicago, Ill.
Buckeye—Unit heaters. Nesbitt, Inc., John J., & Buckeye Blower Co., Philadelphia, Pa.
Bull Dog—Stocks and dies. Oster Mfg. Co., Cleveland, O.
Bull Dog—Tubing. Phelps Dodge Copper Products Corp., New York, N. Y.
Bull Pup—Stocks and dies. Oster Mfg. Co., Cleveland, O.
Burco—Welding apparatus. Burdett Mfg. Co., Chicago, Ill.
C-E—Boilers. Combustion Engineering Co., New York, N. Y.
C-H—Controllers and starters, heaters, relays, switches, valves. Cutler-Hammer, Inc., Milwaukee, Wis.
CJB—Bearings. Ahlberg Bearing Co., Chicago, Ill.
C & M—Hangers or brackets. Carty & Moore Engineering Co., Detroit, Mich.
C. N. I.—Pipe. Walworth Co., New York, N. Y.
COM—Blowers. Wing Mfg. Co., L. J., New York, N. Y.
C-U—Unit heaters. Surface Combustion Corp., Toledo, O.
Cadillac—Meters. Central Station Steam Co., Detroit, Mich.
Cadman—Valves. Barrett Machine Co., N. S., Pittsburgh, Pa.
Calicel—Insulation. Celotex Corp., The, Chicago, Ill.
Calistone—Insulation. Celotex Corp., The, Chicago, Ill.
Calktite—Cement and compounds. U. S. Stonewear Co., New York, N. Y.
Calorider—Air washers, dehumidifiers, unit air conditioners. Research Corp., New York, N. Y.
Cameo—Radiation. Weil-McLain Co., Chicago, Ill.
Capillary—Air washers, dehumidifiers. Air & Refrigeration Corp., New York, N. Y.
Capitol—Boilers, hangers or brackets, heaters, radiation, unit air conditioners. United States Radiator Corp., Detroit, Mich.
Capitol—Insulation. Standard Lime & Stone Co., Baltimore, Md.
Capitolaire—Unit air conditioners. United States Radiator Corp., Detroit, Mich.
Carbo-Cooler—Cooling surface. Mojonnier Bros. Co., Chicago, Ill.
Cascade—Unit air conditioners. Todd Air Conditioning Co., Inc., Bonner Springs, Kans.
Casey-Hedges—Boilers. Combustion Engineering Co., Inc., New York, N. Y.
Castirnare—Electrodes. Universal Power Corp., Cleveland, O.
Catawissa—Unions, valves. Central Forging Co., Catawissa, Pa.
Causul—Valves. Lunkenheimer Co., Cincinnati, O.
Celoron—Couplings. Continental Diamond Fibre Co., Newark, Del.
Centrimax—Meters. Leeds & Northrup Co., Philadelphia, Pa.
Centripac—Packing. Johns - Manville, New York, N. Y.
Century—Boilers. Pierce, Butler Radiator Corp., Syracuse, N. Y.
Chaco—Cement and compounds, boiler and radiator sealing compounds. Desolvo Mfg. Co., Pittsburgh, Pa.
Champion—Wrenches. Greene, Tweed & Co., New York, N. Y.
Charavay—Propeller fans, unit heaters. Hartzell Propeller Fan Co., New York, N. Y.
Charm—Radiation. Thatcher Furnace Co., Newark, N. J.
Chevron — Packing. Garlock Packing Co., Palmyra, N. Y.
Chief—Packing. Keasbey & Mattison Co., Ambler, Pa.
Chieftain — Compressors. Tecumseh Products Co., Tecumseh, Mich.
Chill-Vactor—Steam jet compressors. Croll-Reynolds Engineering Co., Inc., New York, N. Y.
Chinook—Ferrous heating surface. Bayley Blower Co., Milwaukee, Wis.
Chinookfin—Non-ferrous heating surface. Bayley Blower Co., Milwaukee, Wis.
Chip Chaser—Stocks and dies. Oster Mfg. Co., Cleveland, O.
Chromalox—Preheaters, unit heaters. Wiegand Co., Edwin L., Pittsburgh, Pa.
Chronoflo—Flow meters. Builders Iron Foundry, Providence, R. I.
Chronometer—Valves. Defender Automatic Regulator Co., St. Louis, Mo.
Chronotherm—Thermostats. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Circle T—Switches. Trumbull Electric Co., Plainville, Conn.
Circo—Louvers and Shutters. Circulators & Devices Mfg. Corp., New York, N. Y.
CirCOOLator—Fans, ventilators. Viking Air Conditioning Corp., Cleveland, O.
Clarco—Unit heaters. Clarage Fan Co., Kalamazoo, Mich.
Clark-Sundh — Motor controls. Clark Controller Co., Cleveland, O.
Classic—Registers. Auer Register Co., Cleveland, O.
Cle-Bar—Heaters. Cleghorn Co., Boston, Mass.
Climate Changer—Unit air conditioners, unit air coolers. Trane Co., La Crosse, Wis.
Climax—Regulators. Kieley & Mueller, Inc., New York, N. Y.
Climax—Unions. Devlin Mfg. Co., Inc., Thos., Burlington, N. J.
Cocheco—Belting. Williams & Son, I. B., Dover, N. H.
Coey—Cooling towers. Research Corp., New York, N. Y.
Cog-Belt—Transmission drives. Dayton Rubber Mfg. Co., Dayton, O.
Cold Stream—Unit air conditioners. Baker Ice Machine Co., Inc., Omaha, Nebr.
Colonial — Registers. Auer Register Co., Cleveland, O.
Combustioneer—Stokers. Steel Products Engineering Co., Springfield, O.
Comet—Fans, unit heaters. New York Blower Co., Chicago, Ill.
Comfortrol—Effective temperature control. Friez & Sons, Julien P., Baltimore, Md.
Comfostat—Thermostats. Johnson Service Co., Milwaukee, Wis.
Compak—Valves. Commonwealth Brass Corp., Detroit, Mich.
Conco—Boiler cleaning compounds, water treatment. Continental Products Co., Euclid, O.
Conco—Valves. Capitol Brass Division, Bohn Aluminum & Brass Corp., Detroit, Mich.
Condor—Belting, V belts, pipe. Manhattan Rubber Mfg. Div. of Raybestos Manhattan, Inc., Passaic, N. J.
Condo-Vac—Vacuum pumps. Chicago Pump Co., Chicago, Ill.
Con-Tac-Tor — Switches. Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.
Convectofin — Radiation. Commodore Heaters Corp., New York, N. Y.
Cool Wave—Air conditioning units. Philco Radio & Television Corp., Philadelphia, Pa.
Coolair—Fans. American Coolair Corp., Jacksonville, Fla.
Copaltite—Cement and compounds. National Engineering Products, Inc., Washington, D. C.
Copes—Governors. Northern Equipment Co., Erie, Pa.
Cop-R-Loy—Sheets. Wheeling Steel Corp., Wheeling, W. Va.
Corkoustic — Insulation. Armstrong Cork Co., Lancaster, Pa.
Corner Turn—Vanes. Waterloo Register Co., Waterloo, Ia.
Corto—Radiation. American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Coxe—Boilers. Combustion Engineering Co., New York, N. Y.
Crescent—Burners. Caloroil Burner Corp., Hartford, Conn.
Crescent—Unions. Star Mfg. Co., Inc., Providence, R. I.
Cromaloy—Solder. Linde Air Products Co., The, Unit of Union Carbide & Carbon Corp., New York, N. Y.
Crown—Cement and compounds. Colebrook & Sons, Inc., W. H., Syracuse, N. Y.
Crucibleweld — Electrodes. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Cub—Unions. Rhode Island Fittings Co., Hillsgrove, R. I.
Curtis—Regulators, traps, valves. d'Este Co., Julian, Charlestown, Mass.
Cycloidal—Air washers. Blower Application Co., Milwaukee, Wis.
Cyclotherm—Boilers. General Furnaces Corp., New York, N. Y.
DH—Ball bearings. Dodge Mfg. Corp., Mishawaka, Ind.
D & H — Evaporative condensers, cooling and heating surfaces, unit air conditioners. Drayer & Hanson, Inc., Los Angeles, Cal.
DV—Speed changers, v-belt drives. Dodge Mfg. Corp., Mishawaka, Ind.
Dart—Unions. Fairbanks Co., New York, N. Y.
Dean—Cleaners. Pierce Co., Wm. B., Buffalo, N. Y.
Decalorator—Steam jet compressors. Ross Heater & Mfg. Co., Inc., Buffalo, N. Y.
Deflecto—Roof ventilators. Day Co., The, Minneapolis, Minn.
Deflect-O-Grille—Grilles. U. S. Air Conditioning Corp., Minneapolis, Minn.
Detroit—Traps. Nason Co., Detroit, Mich.
Detroit LoStoker—Stokers. Detroit Stoker Co., Detroit, Mich.
Detroit Unistoker — Stokers. Detroit Stoker Co., Detroit, Mich.
Dexter—Air separators. Leavitt Machine Co., Orange, Mass.
Dexter-Goebel — Systems, regulators. National Brass Co., Grand Rapids, Mich.
Dezert Kooler—Units. Utility Fan Corp., Los Angeles, Cal.
Diamond Fibre—Gaskets. Continental Diamond Fibre Co., Newark, Del.
Diamond H — Switches, thermostats. Hart Mfg. Co., Hartford, Conn.
Difr-enshal-Vacm — Heating systems. Dunham Co., C. A., Chicago, Ill.
Directherm—Direct fired heaters. Airtherm Mfg. Co., St. Louis, Mo.
Discfin—Cooling surface. General Refrigeration Corp., Beloit, Wis.
Domic—Heaters. Central Radiator Co., New York, N. Y.
Dominion—Gaskets, packing. Darcoid Co., Inc., New York, N. Y.
Dorex—Odor adsorbers. Connor Engineering Corp., W. B., Dorex Air Conditioning Div., New York, N. Y.
Double Diamond — Hygrometers, recorders, psychrometers. H-B Instrument Co., Philadelphia, Pa.

Double-Seal—Copper tube fittings. Hays Mfg. Co., Erie, Pa.
Draftite—Cement, Keasbey & Mattison Co., Ambler, Pa.
Draftrite — Gages. Bacharach Industrial Instrument Co., Pittsburgh, Pa.
Drainator — Traps. Coe Mfg. Co., Painesville, O.
Dry-Clone—Dust collectors. Sturtevant Mill Co., Boston, Mass.
Dry-paC—Covering. Ric-wiL Co., Cleveland, O.
Dual-Clone—Dust collectors. Day Co., The, Minneapolis, Minn.
Dualsteel—Unions. Rockwood Sprinkler Co., Worcester, Mass.
Dual-System—Hot water heating systems. General Blower Co., Inc., Philadelphia, Pa.
Duco—Enamels and lacquers. du Pont de Nemours & Co. (Inc.), E. I., Fabrics & Finishes Dept., Wilmington, Del.
Dulux—Enamels and lacquers. du Pont de Nemours & Co. (Inc.), E. I., Fabrics & Finishes Dept., Wilmington, Del.
Dunco—Relays, switches, thermostats. Dunn Inc., Struthers, Philadelphia, Pa.
Duofio—Pipe line strainers. Sheffler-Gross Co., Philadelphia, Pa.
Duo-Stat — Heating systems, thermostats. Johnson Service Co., Milwaukee, Wis.
Duplex—Insulation. Keasbey & Mattison Co., Ambler, Pa.
DuraBilt—Registers. Auer Register Co., Cleveland, O.
Dura-Flo—Registers. Auer Register Co., Cleveland, O.
DuraSpeed—Sprinkler heads. Grinnell Co., Inc., Providence, R. I.
Duro—Valves. Lunkenheimer Co., Cincinnati, O.
Duroline — Pipe. National Tube Co., United States Steel Corp. Sub., Pittsburgh, Pa.
Dustrol—Dust collectors. Falstrom Co., Passaic, N. J.
Dust-Stop—Air filters. Owens-Corning Fiberglas Corp., Toledo, O.
Dustube—Dust collectors. American Foundry Equipment Co., Mishawaka, Ind.
Dux-Sulation—Insulation. Wilson, Inc., Grant, Chicago, Ill.
EC & M—Motor controls. Electric Controller & Mfg. Co., Cleveland, O.
Enfco—Fittings. Eastern Foundry Co., Boyertown, Pa.
Eastwood—Boilers, radiation. Pierce, Butler Radiator Corp., Syracuse, N. Y.
Easy-Flo—Solder. Handy & Harman, New York, N. Y.
Easyweld—Electrodes. Universal Power Corp., Cleveland, O.
Eclipse—Governors, regulators, traps, valves. Illinois Engineering Co., Chicago, Ill.
Economy—Boilers, heaters. International Heater Co., Utica, N. Y.
Economy—Registers. Auer Register Co., Cleveland, O.
Economy—Regulators. Dockson Co., C. H., Detroit, Mich.
Economy—Traps. International Nutyp Tool Corp., Oswego, N. Y.
Economy—Unit ventilators. Arex Co., Chicago, Ill.
Effco—Louvers and shutters. Hirschman Co., W. F., Buffalo, N. Y.
Electo-Wind—Ventilators. Allen Corp., Detroit, Mich.
Electrap—Pumps. Johnson Corp., Three Rivers, Mich.
Electra-Vac—Pumps. Johnson Corp., Three Rivers, Mich.
Electro-Matic—Air cleaners. American Air Filter Co., Inc., Louisville, Ky.
Electromode—Electric heaters. Electric Air Heater Co., Div., American Foundry Equipment Co., Mishawaka, Ind.
Electro-Sheet—Sheets. American Brass Co., Waterbury, Conn.
Electrozone—Ozone apparatus. Automatic Pump & Softener Corp., Rockford, Ill.
Electrunite—Stainless steel tubing. Steel and Tubes, Div. of Republic Steel Corp., Cleveland, O.
Elite—Registers. Auer Register Co., Cleveland, O.
Emco—Regulators. Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
Emergency—Steam traps. Wright-Austin Co., Detroit, Mich.
Enco—Burners, regulators. Engineer Co., New York, N. Y.
Enduro—Packing. Keasbey & Mattison Co., Ambler, Pa.
Enduro—Pipe, sheets, tubing. Republic Steel Corp., Cleveland, O.
Enduro—Unions. Lockport Fittings Co., Inc., Lockport, N. Y.
Equarad—Zone control radiator valve. Tallmadge & Co., Webster, East Orange, N. J.
Equatherm—Zone control thermostat. Tallmadge & Co., Webster, East Orange, N. J.
Equiflo—Valves. Grinnell Co., Inc., Providence, R. I.
Esso—Burners, heaters. Gilbert & Barker Mfg. Co., Springfield, Mass.
Eureka—Regulators, valves. Kieley & Mueller, Inc., New York, N. Y.
Eureka—Valves. Ohio Pattern Wks. & Foundry Co., Eureka Valve Div., Cincinnati, O.
Evactor—Pumps. Croll-Reynolds Engineering Co., Inc., New York, N. Y.
Evco—Valves. Electric Valve Mfg. Co., Inc., New York, N. Y.
Evenaction—Valves. Taylor Instrument Companies, Rochester, N. Y.
Evenaire—Insulation. Plastergon Wall Board Co., Buffalo, N. Y.
Everdur—Pipe, tubing, welding rod. American Brass Co., Waterbury, Conn.
Excel—Unions. Lockport Fittings Co., Inc., Lockport, N. Y.
Excelso — Water heaters. American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Exhaustair—Fans. New York Blower Co., Chicago, Ill.
Extra Dry Esotoo—Liquid sulphur dioxide. Virginia Smelting Co., West Norfolk, Va.
Eye-Hye—Gages. Reliance Gauge Column Co., Cleveland, O.
F & E—Stokers. Flynn & Emrich Co., Baltimore, Md.
Fabrikated—Grilles, registers. Independent Register Co., Cleveland, O.
Falcon—Preheaters. Swoboda, Inc., H. O., New Brighton, Pa.
Fanmix—Burners. Coppus Engineering Corp., Worcester, Mass.
Fantom—Radiation. American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Farragut—Packing. Darcoid Co., Inc., New York, N. Y.
Favorite—Wrenches. Greene, Tweed & Co., New York, N. Y.
Featherfin—Heating and cooling surface. Wing Mfg. Co., L. J., New York, N. Y.
Featherweight—Unit heaters. Wing Mfg. Co., L. J., New York, N. Y.
Fel-Pro—Gaskets, packing. Felt Products Mfg. Co., Chicago, Ill.
Fero — Radiation. Burnham Boiler Corp., Irvington, N. Y.
Ferrenewo—Valves. Lunkenheimer Co., Cincinnati, O.
Ferrocind—Insulation. Truscon Steel Co., Youngstown, O.
Ferro-Therm — Insulation. American Flange & Mfg. Co., Inc., New York, N. Y.
Ferroweld—Electrodes. Lincoln Electric Co., Cleveland, O.
Fiberglas—Insulation. Owens-Corning Fiberglas Corp., Toledo, O.
Fields—Cement and compounds. Grinnell Co., Inc., Providence, R. I.
Filmflo—Deaerators, separators. Croll-Reynolds Engineering Co., Inc., New York, N. Y.
Filteraire—Window ventilator and filter units. Davies Air Filter Corp., New York, N. Y.
Fin-Flex—Registers. Auer Register Co., Cleveland, O.
Fin-Flo—Registers. Auer Register Co., Cleveland, O.
Findlay—Stokers. Bluffton Mfg. Co., The, Findlay, O.
Fire Tender—Stokers. Holcomb & Hoke Mfg.Co., Indianapolis, Ind.
Five Star—Boilers. Smith Co., Inc., H. B., The, Westfield, Mass.
Fleetweld—Electrodes. Lincoln Electric Co., Cleveland, O.
Flexarc—Arc welders. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Flexair—Grilles, registers. Tuttle & Bailey, Inc., New Britain, Conn.
Flexcord—Drives. Gates Rubber Co., Denver, Colo.
Flexeal—Gaskets. Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.
Flexiwound—Gaskets. Azor Corp., Newark, N. J.
Flexodisc — Expansion joints. Croll-Reynolds Engineering Co., Inc., New York, N. Y.
Flextan—Packing. Chicago Belting Co., Chicago, Ill.
Flo-Klean—Filters, strainers. Cuno Engineering Corp., Meriden, Conn.
Flo-watch—Flow meters. Builders Iron Foundry, Providence, R. I.
Flualyzer—Analyzers. Engelhard, Inc., Chas., Newark, N. J.
Forcedraft—Unit air coolers. Fedders Mfg. Co., Inc., Buffalo, N. Y.
Force-Flo—Circulators, heaters, regulators, systems. Kehm Corp., The, Chicago, Ill.
Fordair—Compressors. Schramm, Inc., West Chester, Pa.
Forest Fleece—Insulation. Doheny Co., John J., Belmont, Mass.
Fosco—Heaters, ventilators. Schoedinger, F. O., Columbus, O.
Francke—Flexible couplings. Waldron Corp., John, New Brunswick, N. J.
Freeflo—Grilles. Trane Co., La Crosse, Wis.
Freon—Refrigerant. Kinetic Chemicals, Inc., Wilmington, Del.
Fretz—Nipples. Devlin Mfg. Co., Inc., Thos., Burlington, N. J.
Frevent—Valves. Russell & Co., W. A., Bridgeport, Conn.
Frigistat — Thermostats. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Frigid—Propeller fan blades and fans. Circulators & Devices Mfg. Corp., New York, N. Y.
Frigitower—Cooling towers. Schubert-Christy Corp., St. Louis, Mo.
Fuel Saver — Boilers. International Boiler Wks. Co., East Stroudsburg, Pa.
Fulscope — Recorders, recorder - controllers, regulators. Taylor Instrument Companies, Rochester, N. Y.
fYBa—Motor operated valves. Barber-Colman Co., Rockford, Ill.
Fyr-Feeder—Stokers. American Coal Burner Co., Chicago, Ill.
G.B.C.—Circulators, pressure blowers, shutters. General Blower Co., Inc., Philadelphia, Pa.
G-M—Grilles, louvers and shutters, registers. Gillian Mfg. Co., Ferndale, Mich.
GTD—Pipe vises and wrenches. Greenfield Tap & Die Corp., Greenfield, Mass.
Gale—Ducts, grilles, registers. Char-Gale Mfg. Co., Minneapolis, Minn.
Gast—Filters, separators. Johnson Corp., Three Rivers, Mich.
Geddes—Radiation. Fowler & Wolfe Radiator Co., Norristown, Pa.
Gemaco—Compressors. General Machinery Co., Spokane, Wash.
Gemware — Hygrometers, psychrometers, thermometers. G. M. Mfg. Co., New York, N. Y.
Genasco—Insulation, pipe joint cement and compounds. Barber Asphalt Corp., Barber, N. J.
Genuine Detroit—Gages, humidistats, operators, switches, thermostats, valves. Detroit Lubricator Co., Detroit, Mich.
Geyser—Water heaters. Thatcher Furnace Co., Newark, N. J.
Giant—Unit heaters. Nesbitt, Inc., John J., & Buckeye Blower Co., Philadelphia, Pa.
Gilbarco—Burners, heaters, compressors, regulators, unit air conditioners. Gilbert & Barker Mfg. Co., Springfield, Mass.
Gilt Edge—Belting. Rhoads & Sons, J. E., Philadelphia, Pa.
Gimco—Insulation. General Insulating & Mfg. Co., St. Louis, Mo.
Gland-Pakt—Expansion joints. Yarnall-Waring Co., Philadelphia, Pa.
Globe—Ventilators. Osborn Co., The J. M. & L. A., Cleveland, O.

Gloco Red Band—Water heaters. Glore Sales Corp., Evins F., New York, N. Y.

Goetzerit—Packing. Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.

Gohi — Sheets. Newport Rolling Mill Co., Newport, Ky.

Golden Rod—Blower wheels, fans, heaters, unit air conditioners. Jaden Mfg. Co., Inc., F., Hastings, Neb.

Gothic—Radiation. Thatcher Furnace Co., Newark, N. J.

Gradustat — Regulators, thermostats. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Graylite—Insulation. Insulite Co., Minneapolis, Minn.

Greastop—Air filters. Air-Maze Corp., Cleveland, O.

Grid—Unit heaters. Unit Heater & Cooler Co., Wausau, Wis.

Grillometer—Direct reading air velocity meters. Detroit Air Meter Co., Detroit, Mich.

Guardian—Gaskets. Garlock Packing Co., Palmyra, N. Y.

Gulf Stream—Hot water circulators, heaters, regulators, heating systems, thermostats and check valves. Atlantic Valve & Pump Co., Chicago, Ill.

Gun-Pakt—Expansion joints. Yarnall-Waring Co., Philadelphia, Pa.

H-B—Boilers. Smith Co., H. B., Westfield, Mass.

H & C—Grilles, registers. Hart & Cooley Mfg. Co., Chicago, Ill.

H-O-H—Compounds, water treatment. Haering & Co., Inc., D. W., Chicago, Ill.

Hager—Separators. Textite Corp., Chicago, Ill.

Hairbestos—Insulation. Wilson & Co., Chicago, Ill.

Hammerkraft—Enamels and lacquers. Hilo Varnish Corp., Brooklyn, N. Y.

Hammer-Set—Bolts. Rawlplug Co., Inc., The, New York, N. Y.

Handy—Benders. Holsclaw Bros., Inc., Evansville, Ind.

Handy — Valves. Lunkenheimer Co., Cincinnati, O.

Handy Andy—Vise stands. Western Wire Products Co., St. Louis, Mo.

Hardweld—Electrodes. Lincoln Electric Co., Cleveland, O.

Haveg—Tanks. Continental Diamond Fibre Co., Newark, Del.

Hazleton—Pumps, strainers, valves. Barrett, Haentjens & Co., Hazleton, Pa.

Heat Extractor—Boilers. National Radiator Corp., Johnstown, Pa.

Health-Air—Ventilator and filter units. Ad-Lee Co., Inc., Chicago, Ill.

Health-Aire—Fans, heaters, unit coolers, ventilators. Johnson Fan & Blower Co., Chicago, Ill.

Healthe-Aire — Humidifiers. Skilbeck Mfg. Co., Kenosha, Wis.

Heath—Manometers. Detroit Air Meter Co., Detroit, Mich.

Hentomat—Heaters. Richmond Radiator Co., Gas Products Div., Uniontown, Pa.

Helical—Tubing. Rome-Turney Radiator Co., Rome, N. Y.

Hensel—Welders. Maple Valley Mfg. Co., Mapleton, Ia.

Hercules—Fans. Hirschman Co., W. F., Buffalo, N. Y.

Herculoy—Tubing, welding rod. Revere Copper & Brass, Inc., New York, N. Y.

Hevikoat—Electrodes. Universal Power Corp., Cleveland, O.

Highflex—Belting. Goodrich Co., B. F., Akron, O.

High-Temp—Packing. Keasbey & Mattison Co., Ambler, Pa.

Hijet—Unit heaters. Nelson Corp., Herman, Moline, Ill.

Hilger — Coils, refrigerating compressors, unit coolers, dehumidifiers, cooling towers, unit air conditioners. XL Refrigerating Co., Inc., Chicago, Ill.

Hi-Lo—Pumps. Yeomans Bros. Co., Chicago, Ill.

Hi-Speed—Brazing torches. Dockson Co., C. H., Detroit, Mich.

Hi-Spra — Spray nozzles. Schubert-Christy Corp., St. Louis, Mo.

Hitchings—Boilers. Burnham Boiler Corp., Irvington, N. Y.

Hi-Temp—Insulation. Carey Co., Philip, Lockland, Cincinnati, O.

Hi-Test—Pipe. Walworth Co., New York, N. Y.

Holby—Valves. Boiler Room Equipment, Inc., New York, N. Y.

Holdfast—Solder. American Brass Co., Waterbury, Conn.

Holt—Strainers. Rosedale Foundry & Machine Co., Pittsburgh, Pa.

Horton—Tanks. Chicago Bridge & Iron Co., Chicago, Ill.

Hot Shot—Pumps. Yeomans Bros. Co., Chicago, Ill.

Hovalco—Valves. Homestead Valve Mfg. Co., Coraopolis, Pa.

Huber—Stokers. Flynn & Emrich Co., Baltimore, Md.

Humidair—Humidifiers. Skilbeck Mfg. Co., Kenosha, Wis.

Humid-Heet—Radiators. Utica Radiator Corp., Utica, N. Y.

Humidigraph — Humidity recorders. Bristol Co., Waterbury, Conn.

Humidiguide—Hygrometers. Taylor Instrument Companies, Rochester, N. Y.

Humidostat—Humidistats. Johnson Service Co., Milwaukee, Wis.

Humi-Temps—Unit air coolers. Larkin Coils, Inc., Atlanta, Ga.

Humphrey—Unit heaters. General Gas Light Co., Kalamazoo, Mich.

Hycarb—Electrodes. Universal Power Corp., Cleveland, O.

Hydramotor—Valves. General Controls Co., Glendale, Cal.

Hydro—Recorders. Bacharach Industrial Instrument Co., Pittsburgh, Pa.

Hydro—Packing. Keasbey & Mattison Co., Ambler, Pa.

Hydro—Valves. Kieley & Mueller, Inc., New York, N. Y.

Hydro-Clone—Dust collectors. Sturtevant Mill Co., Boston, Mass.

Hydron—Bellows, traps. Clifford Mfg. Co., Boston, Mass.

Hy-Duty — Fans. Schwitzer-Cummins Co., Indianapolis, Ind.

Hylo—Heating systems. Webster & Co., Warren, Camden, N. J.

Hy-Temp—Cement, insulation. Keasbey & Mattison Co., Ambler, Pa.

Hy-Test—Water heaters. Smith Co., Inc., H. B., The, Westfield, Mass.

Hytherstat—Combination humidity and temperature control. Friez & Sons, Julien P., Baltimore, Md.

Hytor—Pumps. Nash Engineering Co., South Norwalk, Conn.

I-R—Ingersoll-Rand, New York, N. Y.

Ice-O-Matic — Refrigerating compressors. Williams Oil-O-Matic Heating Corp., Bloomington, Ill.

Ideal—Blowers. Perfection Grate & Stoker Co., Springfield, Mass.

Ideal—Boilers, water heaters, valves. American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.

Ideal — Ventilators. Tuttle & Bailey, Inc., New Britain, Conn.

Ideal—Traps. Nason Co., Detroit, Mich.

Impact—Spray nozzles. Cooling Tower Co., Inc., The, Div. of the Fluor Corp., Ltd., New York, N. Y.

Imperial—Boilers. National Radiator Co., The, Johnstown, Pa.

In-Cel-Wood—Insulation. Cornell Wood Products Co., Chicago, Ill.

IngAclad—Stainless clad sheets. Ingersoll Steel & Disc Co., Chicago, Ill.

Instant—Heaters, preheaters. Johnson Corp., Three Rivers, Mich.

Instant—Water heaters. Sterling Engineering Co., Milwaukee, Wis.

Insulfil—Insulation. Refractory & Insulation Corp., New York, N. Y.

Insulroc—Insulation. Rock Products Co., Nashville, Tenn.

Insulwool—Insulation. General Insulating Products Co., Brooklyn, N. Y.

Ironton—Burners. Continental Stove Corp., Ironton, O.

J—Fittings, flanges, unions. Jenkins Mfg. Co., New York, N. Y.

J F S—Speed changers and reducers. Stephens-Adamson Mfg. Co., Aurora, Ill.

J-M Ball—Foats, traps. Cryer Trap & Valve Co., Inc., New York, N. Y.

J. M. C.—Burners. Johnson Mfg. Co., Waterloo, Ia.

Janitrol—Burners, heaters, unit air conditioners, unit air humidifiers. Surface Combustion Corp., Toledo, O.

Jarco—Unions. Jarecki Mfg. Co., Erie, Pa.

Jennings—Pumps, ejectors. Nash Engineering Co., South Norwalk, Conn.

Jewel—Packing. Keasbey & Mattison Co., Ambler, Pa.

Jointite — Insulation. Mundet Cork Corp., Brooklyn, N. Y.

Jones—Stokers. Riley Stoker Corp., Worcester, Mass.

Jusrite—Ducts and duct fittings. Corbman Bros., Inc., Philadelphia, Pa.

K—Fittings. Kuhns Brothers Co., Dayton, O.

K-S-V—Ventilators. Kernchen Co., Chicago, Ill.

Kable Kord—Belting. Gilmer Co., L. H., Philadelphia, Pa.

Kane—Boilers, gas burners. Mears-Kane-Ofeldt, Inc., Philadelphia, Pa.

Kant Klog—Spray nozzles. Howell Mfg. Co., Kansas City, Mo.

Kathabar — Dehumidifiers, humidifiers, unit air conditioners. Surface Combustion Corp., Toledo, O.

Kearsarge—Gaskets, packing. Johns-Manville, New York, N. Y.

Kelly—Valves. National Metal Products Corp., Chicago, Ill.

Kentucky—Sheets. Newport Rolling Mill Co., Newport, Ky.

Key-Tite—Cement and compounds. Key Co., East St. Louis, Ill.

Kidskin—Packing. Darcoid Co., Inc., New York, N. Y.

Kimsul — Insulation. Kimberly-Clark Corp., Neenah, Wis.

King-clip—Valves. Lunkenheimer Co., Cincinnati, O.

Kleen Tube—Heaters. Vapor Car Heating Co., Inc., Chicago, Ill.

Kleenflo — Unit air filters. Air-Maze Corp., Cleveland, O.

Klixon—Temperature controls. Spencer Thermostat Co., Attleboro, Mass.

K-Master—Strainers, traps. Kaye & Macdonald, Inc., West Orange, N. J.

Kool-Shade — Solar heat resisting screens. Ingersoll Steel & Disc Co., Chicago, Ill.

Kooler-Aire—Commercial air conditioners. U. S. Air Conditioning Corp., Minneapolis, Minn.

Kopp-Sure-Travel—Joints. Kopperman & Sons, Joseph, Philadelphia, Pa.

Krupp—Valves. Shank Co., Cyrus, Chicago, Ill.

Kwic-Lift—Hangers or brackets. Sterling Engineering Co., Milwaukee, Wis.

L. A.—Motors. Louis Allis Co., Milwaukee, Wis.

L&N—Regulators. Leeds & Northrup Co., Philadelphia, Pa.

L-R—Couplings. Lovejoy Flexible Couplings Co., Chicago, Ill.

L. R. D.—Valves. Grinnell Co., Inc., Providence, R. I.

Laddi—Heaters. Johnson Co., S. T. Oakland, Cal.

Lamino—Insulation. Keasbey & Mattison Co., Ambler, Pa.

Lansdale—Heaters. Central Radiator Co., New York, N. Y.

Lavigne—Valves. Commonwealth Brass Corp., Detroit, Mich.

Lawson—Wrenches. U. S. Hame Co., Buffalo, N. Y.

Leader—Stocks and dies. Oster Mfg. Co., Cleveland, O.

Lectrodryer—Dehumidifiers. Pittsburgh Lectrodryer Corp., Pittsburgh, Pa.

Lectro Shear—Shears. Black & Decker Mfg. Co., Towson, Md.

Levolometer—Gages, recorders. Liquidometer Corp., Long Island City, N. Y.

Liberty—Packing. Johns-Manville, New York, N. Y.

Lima—Stokers. Carnes, Inc., John R., Lima, O.

Limit-Load—Centrifugal fans. Buffalo Forge Co., Buffalo, N. Y.

Limpet—Insulation. Keasbey & Mattison Co., Ambler, Pa.

Linc-Weld—Motors. Lincoln Electric Co., Cleveland, O.

Lipman—Compressors, cooling surface, unit air conditioners. General Refrigeration Corp., Beloit, Wis.

Liquivator—Pumps. Morehead Mfg. Co., Detroit, Mich.

Little Giant—Pipe extractors, vises, stocks and dies. Greenfield Tap & Die Corp., Greenfield, Mass.

Little Giant—Radiation. Pierce, Butler Radiator Corp., Syracuse, N. Y.

Little Giant—Switches, Tork Clock Co., Inc., Mt. Vernon, N. Y.

Lo-Blast—Burners. National Machine Wks., Chicago, Ill.

Locarb—Electrodes. Universal Power Corp., Cleveland, O.

Lockaire—Insulation. Plastergon Wall Board Co., Buffalo, N. Y.

Logan—Radiation. Logansport Radiator Equipment Co., Logansport, Ind.

Lok-Joint — Insulation. Insulite Co., Minneapolis, Minn.

Lolag—Heaters. American Instrument Co., Silver Spring, Md.

Longrip—Pipe extractors. Ridge Tool Co., Elyria, O.

Lord Burnham—Boilers. Burnham Boiler Corp., Irvington, N. Y.

Lowcost—Boilers. Murray Iron Wks., Co., Burlington, Ia.

Low Temp — Insulation. Insulite Co., Minneapolis, Minn.

Lubricore—Packing. Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.

Lul—Unit coolers. Merchant & Evans Co., Philadelphia, Pa.

Luminarc—Electrodes. Universal Power Corp., Cleveland, O.

Lyonore—Sheets. Lyon, Conklin & Co., Inc., Baltimore, Md.

M. & E. — Refrigerating compressors. Merchant & Evans Co., Philadelphia, Pa.

M & M—Feeders, switches, valves. McDonnell & Miller, Chicago, Ill.

M & S—Gaskets, insulation. Mitchell & Smith, Inc., Detroit, Mich.

MIF — Couplings, fittings. Malleable Iron Fittings Co., Branford, Conn.

MJL — Manometers, meters, recorders. Morey & Jones, Ltd., Los Angeles, Cal.

MKO — Boiler feeders. Mears-Kane-Ofeldt, Inc., Philadelphia, Pa.

M/W and A/C Airmat — Air filters. American Air Filter Co., Inc., Louisville, Ky.

Machetn—Fans, fan blades. Aerovent Fan Co., Piqua, O.

Magic-Weather — Air washers, fans, unit air coolers. Ballantyne Co., Omaha, Nebr.

Majestic — Boilers. Ames Iron Wks., Div. of Pierce Butler Radiator Corp., Oswego, N. Y.

Manganweld—Electrodes. Lincoln Electric Co., Cleveland, O.

Mark Time—Time switches. Rhodes, Inc., M. H., Hartford, Conn.

Martell—Packing. France Packing Co., Tacony, Philadelphia, Pa.

Massachusetts — Fans, unit heaters, blower wheels, air washers. Bishop & Babcock Mfg. Co., Cleveland, O.

Master—Stokers. Muncie Gear Wks., Inc., Muncie, Ind.

Master—Thermostats, switches. White Mfg. Co., St. Paul, Minn.

Master—Unions. Lockport Fittings Co., Inc., Lockport, N. Y.

Mayflower—Refrigerating compressors. Hardy Mfg. Co., Inc., Dayton, O.

McDaniel—Floats, traps. Watson & McDaniel Co., Philadelphia, Pa.

McKee—Blowers, boilers, burners, feeders, pumps, regulators, tanks, torches, valves. Eclipse Fuel Engineering Co., Rockford, Ill.

McKeesport — Radiation. Columbia Radiator Co., McKeesport, Pa.

McKnight—Registers. Tuttle & Bailey, Inc., New Britain, Conn.

Measurrench — Wrenches. Williams & Co., J. H., New York, N. Y.

Mechanovent—Ventilators. New York Blower Co., Chicago, Ill.

Mel-Rock—Humidifiers, units, ventilators, washers. Mellish & Murray Co., Chicago, Ill.

Menlo—Water heaters. Smith Co., Inc., H. B., The, Westfield, Mass.

Merkustat — Regulators, switches. Marsh Corp., Jas. P., Chicago, Ill.

Merrill Process — Heating systems. Parks-Cramer Co., Fitchburg, Mass.

Metermax — Combustion control systems. Leeds & Northrup Co., Philadelphia, Pa.

Metrotherm — Thermostats. General Controls Co., Glendale, Cal.

Micromax — Recorders, recorder-controllers, thermometers. Leeds & Northrup Co., Philadelphia, Pa.

Microstat—Thermostats. Friez & Sons, Julien P., Baltimore, Md.

Midget — Radiation. Utica Radiator Corp., Utica, N. Y.

Mills—Boilers. Smith Co., Inc., H. B., The, Westfield, Mass.

Milvaco—Air eliminators, floats, heating systems, radiator orifices, strainers, traps, unions, valves. Milwaukee Valve Co., Milwaukee, Wis.

Milwaukee—Heaters. Blower Application Co., Milwaukee, Wis.

Milwaukee—Stokers. Automatic Stoker Corp., Milwaukee, Wis.

Mir-O-Meter—Combustion control systems. Bowser & Co., Inc., S. F., Fort Wayne, Ind.

Mirro-Matic—Heaters. Handley Brown Heater Co., Jackson, Mich.

Mirro-Shell—Heaters. Handley Brown Heater Co., Jackson, Mich.

MKayO — Boilers. Mears-Kane-Ofeldt, Inc., Philadelphia, Pa.

Mobilaire—Unit air coolers. Westinghouse Electric & Mfg. Co., East Springfield, Mass.

Mobilene — Gaskets. Johns-Manville, New York, N. Y.

Moderator—Heating system. Warren Webster Co., Camden, N. J.

Modustat — Valves. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Modutrol—Heating systems. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Mogul—Packing. Johns-Manville, New York, N. Y.

Mohawk—Pipe. Cohoes Rolling Mill Co., Cohoes, N. Y.

Moncrief—Sheet metal pipe and fittings. Henry Furnace & Foundry Co., Cleveland, O.

Mono-Cast—Pipe. American Cast Iron Pipe Co., Birmingham, Ala.

Morflex — Flexible couplings. Morse Chain Co., Ithaca, N. Y.

Mortex—Insulation. Mortell Co., J. W., Chicago, Ill.

Mosher—Separators. Barrett Machine Co., N. S., Pittsburgh, Pa.

Motoco — Recorders, thermometers. Electric Auto-Lite Co., Moto Meter Gauge & Equipment Div., La Crosse, Wis.

Motopump—Pumps. Yeomans Bros. Co., Chicago, Ill.

Motorstoker—Stokers. Hershey Machine & Foundry Co., Motorstoker Div., Manheim, Pa.

Mototurb—Ventilators. Uno Ventilator Co., Cliftondale, Mass.

Muffletone—Insulation. Celotex Corp., The, Chicago, Ill.

Multiclones—Dust collectors. Research Corp., New York, N. Y.

Multiflex—Valves. Wheeler Mfg. Co., C. H., Philadelphia, Pa.

Multi-Panel—Air filters. American Air Filter Co., Inc., Louisville, Ky.

Multiseal—Gaskets. Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.

Multitherm—Air conditioning units. Clarage Fan Co., Kalamazoo, Mich.

Multivane—Fans and blowers. B. F. Sturtevant Co., Boston, Mass.

Multi-Vane—Ventilators. Allen Corp., Detroit, Mich.

Multi-Wash—Dust collectors. Schneible Co., Claude B., Chicago, Ill.

Murco—Unit heaters. Unit Heater & Cooler Co., Wausau, Wis.

Murex—Welding electrodes. Metal & Thermit Corp., New York, N. Y.

Murray—Radiation. American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.

N-M-D — Valves. Lunkenheimer Co., Cincinnati, O.

NYBCo Steelfin—Heating surface. New York Blower Co., Chicago, Ill.

National—Compressors. Janette Mfg. Co., Chicago, Ill.

National—Pumps. Austin-Mason Co., New York, N. Y.

Naturzone—Insulation. Wilson & Co., Chicago, Ill.

Nelson—Stokers. Heating Assurance, Inc., Spokane, Wash.

Nemo—Insulating cement. Smith & Kanzler, Inc., Elizabeth, N. J.

New Cyclone—Dust collectors. Kirk & Blum Mfg. Co., Cincinnati, O.

New Kathode — Electrodes. Lincoln Electric Co., Cleveland, O.

New Lightweld — Electrodes. Lincoln Electric Co., Cleveland, O.

Newport—Humidistats. Johnson Tool Co., East Providence, R. I.

New Standard—Traps. Kieley & Mueller, Inc., New York, N. Y.

Niagara—Meters, strainers. Buffalo Meter Co., Buffalo, N. Y.

Nibco—Fittings, heads, joints, nozzles, valves. Northern Indiana Brass Co., Elkhart, Ind.

Ni-Resist—Pipe. Walworth Co., New York, N. Y.

Non-clog—Sewage ejectors. Chicago Pump Co., Chicago, Ill.

Non-Clog—Pipe line strainers. Boylston Steam Specialty Co., Chicago, Ill.

Non-Con-Dux—Cement, covering. Wilson, Inc., Grant, Chicago, Ill.

Non-Flash—Brazing torches, welding and cutting apparatus. Torchweld Equipment Co., Chicago, Ill.

Non-Frost — Insulation. Keasbey & Mattison Co., Ambler, Pa.

Non-Sweat — Insulation. Keasbey & Mattison Co., Ambler, Pa.

Norblo—Dust collectors, fans, filters, washers. Northern Blower Co., Cleveland, O.

Nordstrom—Valves. Merco-Nordstrom Valve Co., Pittsburgh, Pa.

Northwind—Unit air coolers. Pleasantaire Corp., Washington, D. C.

Norwesco—Cement and compounds, boiler and radiator sealing compounds. Atlas Chemical Co., Marietta, O.

No-Thread—Fittings. Dresser Mfg. Co., Bradford, Pa.

No-Ve-U—Door ventilators. Waterloo Register Co., Waterloo, Ia.

Novoid—Insulation. Cork Import Corp., New York, N. Y.

Novus—Boilers. National Radiator Co., The, Johnstown, Pa.

Nu-Air—Fans. Meier Electric & Machine Co., Indianapolis, Ind.

Nu-Air—Ventilators. Milcor Steel Co., Milwaukee, Wis.

Nu-Alpina—Ventilators. Milcor Steel Co., Milwaukee, Wis.

Nu-Notch — Mushroom ventilators. Knowles Mushroom Ventilator Co., Montclair, N. J.

OB—Valves, unions. Ohio Brass Co., Mansfield, O.

OK—Motors. Marathon Electric Mfg. Corp., Wausau, Wis.

OK—Stocks and dies. Greenfield Tap & Die Corp., Greenfield, Mass.

Ofeldt — Boilers. Mears-Kane-Ofeldt, Inc., Philadelphia, Pa.

Oil-O-Matic — Oil burners. Williams Oil-O-Matic Heating Corp., Bloomington, Ill.

Ol' Faithful—Humidifiers. Maid-O-Mist, Inc., Chicago, Ill.

Oriflex—Valves. Dunham Co., C. A., Chicago, Ill.

Oswego—Cutters, punches, wrenches. International Nutyp Tool Corp., Oswego, N. Y.

Oxford—Unions. Standard Union Co., New York, N. Y.

Oxweld—Welding rod, welding and cutting apparatus. Linde Air Products Co., The, New York, N. Y.

PDQC — Pipe machines. Bignall & Keeler Machine Wks., Edwardsville, Ill.

P & H—Welding electrodes. Harnischfeger Corp., Milwaukee, Wis.

P & H—Hansen—Arc Welders. Harnischfeger Corp., Milwaukee, Wis.

Packaged Steam—Boilers. PS Inc., Los Angeles, Cal.

Paintgrip — Sheets. American Rolling Mill Co., The, Middletown, O.

Palco—Packing. Greene, Tweed & Co., New York, N. Y.

Palco Wool—Insulation. Pacific Lumber Co., The, San Francisco, Cal.

Palmetto—Packing. Greene, Tweed & Co., New York, N. Y.

Par—Condensing units. Modern Equipment Corp., Defiance, O.

Paracoil — Heaters, preheaters. Davis Engineering Corp., Elizabeth, N. J.

Parko—Psychrometers. Parks-Cramer Co., Fitchburg, Mass.

Pebble—Registers. Auer Register Co., Cleveland, O.

Pebco—Boilers. Pierce, Butler Radiator Corp., Syracuse, N. Y.

Peerless—Dust collectors, humidifiers, air washers. New York Blower Co., Chicago, Ill.

Peerless—Pipe machines. Bignall & Keeler Machine Works, Edwardsville, Ill.

Penn-M-Co—Fittings. Penn Mfg. Corp. of Washington, Pa., Washington, Pa.

Perfection—Plates. Beaton & Cadwell Mfg. Co., New Britain, Conn.

Perfection—Regulators, valves. American District Steam Co., North Tonawanda, N. Y.

Permalined—Pipe. Jones & Laughlin Steel Corp., Pittsburgh, Pa.

Permanite—Packing. Keasbey & Mattison Co., Ambler, Pa.

Petro—Oil burners. Petroleum Heat & Power Co., Stamford, Conn.

Pexto — Brakes, punches, shears, wrenches. Peck, Stow & Wilcox Co., Southington, Conn.

Pipe Master—Pipe cutting machines. Oster Mfg. Co., Cleveland, O.

Pipemaster—Wrenches. Erie Tool Wks., Erie, Pa.

Piteo—Unions. Pittsburgh Valve & Fittings Corp., Barberton, O.

Pittsburgh—Unit heaters. Automatic Gas Steam Radiator Co., Pittsburgh, Pa.

Plasgon—Cement and compounds. Cabot, Inc., Samuel, Boston, Mass.

Plasti-Calk —Caulking compounds. Chamberlin Metal Weather Strip Co., Detroit, Mich.

Plastiseal — Cement and Compounds. Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.

Playford—Stokers. Rosedale Foundry & Machine Co., Pittsburgh, Pa.

Plexifin—Unit heaters. Bayley Blower Co., Milwaukee, Wis.

Plexiform—Fans. Bayley Blower Co., Milwaukee, Wis.

Plumrite—Pipe. Bridgeport Brass Co., Bridgeport, Conn.

Plymco—Air filters. Plymouth Cordage Co., N. Plymouth, Mass.; Anderson Products, Inc., Cambridge, Mass. National Sales Agents.

Polartron—Relays, switches. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Porto-Power—Pipe benders. Blackhawk Mfg. Co., Milwaukee, Wis.

Power—Belting. Rhoads & Sons, J. E. Philadelphia, Pa.

Power Boy—Pipe cutting and threading machines. Oster Mfg. Co., Cleveland, O.

Precipitron — Air cleaners. Westinghouse Electric & Mfg. Co., Cleveland, O.

Premier—Boilers. Combustion Engineering Co., Inc., New York, N. Y.

Premier — Boilers, heaters. National Radiator, Co., The, Johnstown, Pa.

Premier—Welding rod, electrodes. American Steel & Wire Co., Cleveland, O.

Presstico—Insulation. Presstite Engineering Co., St. Louis, Mo.

Pressuretrol — Regulators, switches. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Prest-O-Lite—Leak detectors, torches. Linde Air Products Co., The, Unit of Union Carbide & Carbon Corp., New York, N. Y.

Prest-O-Weld — Welding and cutting apparatus. Linde Air Products Co., The, New York, N. Y.

Princo—Anemometers, gages, hygrometers, manometers, psychrometers, regulators, relays, thermometers, thermostats. Precision Thermometer & Instrument Co., Philadelphia, Pa.

Probestos—Gasket. Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.

Protectomotor—Air filters. Staynew Filter Corp., Rochester, N. Y.

Protectorelay — Relays. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Protectovent—Window ventilator and filter units. Staynew Filter Corp., Rochester, N. Y.

Pulling—Pumps. Columbus Steam Pump Works Co., Columbus, O.

Pulverzone—Stokers. American Coal Burner Co., Chicago, Ill.

Punkah—Louvers and shutters. Kelvin-White Co., Boston, Mass.

Purox—Electrodes, welding and cutting apparatus. Linde Air Products Co., The, Unit of Union Carbide & Carbon Corp., New York, N. Y.

Pyralux—Enamels and lacquers. du Pont de Nemours & Co. (Inc.), E. I., Fabrics & Finishes Dept., Wilmington, Del.

Pyrex—Glass pipe. Corning Glass Wks., Corning, N. Y.

Pyro—Thermometers, recorders, regulators. Pyrometer Instrument Co., New York, N. Y.

Pyrofelt—Insulation. Minfelt Insulation Co., The, Toledo, O.

Pyroment—Cement. Keasbey & Mattison Co., Ambler, Pa.

Q. F. R.—Pipe, tubing. Wheatland Tube Co., Philadelphia, Pa.

Q-T—Insulation. Celotex Corp., The, Chicago, Ill.

QT—Unit heaters. Kisco Boiler & Engineering Co., St. Louis, Mo.

Quartzoid—Sprinkler heads. Grinnell Co., Inc., Providence, R. I.

Quintuplet—Valves. Maid-O-Mist, Inc., Chicago, Ill.

RB Pressure—Pressure blowers. Western Blower Co., Seattle, Wash.

R & G—Grilles, registers. Register & Grille Mfg. Co., Brooklyn, N. Y.

R-K—Combustion control systems, regulators. Ruggles-Klingemann Mfg. Co., Salem, Mass.

R & M—Motors. Robbins & Myers, Inc., Springfield, O.

R-P Zeolite—Water treatment. Research Products Corp., Madison, Wis.

R. P. & C.—Valves. Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., Bridgeport, Conn.

R-U-F—Fans. Reed Unit-Fans, Inc., New Orleans, La.

Racine—Time switches. Reliance Automatic Lighting Co., Racine, Wis.

Radiatherm—Valves. American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.

Radiant-Vector — Radiation. Pierce, Butler Radiator Corp., Syracuse, N. Y.

Radi-Ion—Ionization apparatus. Moptgomery Bros., San Francisco, Cal.

Radolite—Cement. Pyrolite Products Co., Cleveland, O.

Rainbow—Humidifiers. Sheer Co., H. M., Quincy, Ill.

Rainbow Mist — Nozzles. Peterson Freezem Mfg. & Sales Co., Kansas City, Mo.

Rajah—Packing. Johns-Manville, New York, N. Y.

Rapiduction—Pipe cutting machines. Oster Mfg. Co., Cleveland, O.

Raybould — Couplings. Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

Raydiant—Radiation. Weil-McLain Co., Chicago, Ill.

Reco—Motors. Reynolds Electric Co., Chicago, Ill.

Reco—Condensers, heaters, preheaters, tanks, unit coolers. Richmond Engineering Co., Richmond, Va.

Record-O-Stat — Recorder - Controllers. Johnson Service Co., Milwaukee, Wis.

Recoy—Chillers, condensers, cooling surface, unit coolers. Refrigeration Economics Co., Inc., Canton, O.

Red—Controllers, ejectors, operators, regulators, switches, valves. Cooper Co., Clark, Philadelphia, Pa.

Red Band—Motors. Howell Electric Motors Co., Howell, Mich.

Red Devil—Cement. Pecora Paint Co., Philadelphia, Pa.

Red Diamond—Conduit, pipe. American District Steam Co., North Tonawanda, N. Y.

Red Dome—Heaters. Smith Co., Inc., H. B., The, Westfield, Mass.

Red Flash—Traps. Ellis Drier Co., Chicago, Ill.

Red Head—Tongs. Billings & Spencer Co., Hartford, Conn.

Red Head—Traps. Ellis Drier Co., Chicago, Ill.

Redi—Stokers. General Machinery Co., Spokane, Wash.

Redsquare — Boilers. Utica Radiator Corp., Utica, N. Y.

Red Top — Humidistats, thermostats. H-B Instrument Co., Philadelphia, Pa.

Reliance—Packing. Chicago Belting Co., Chicago, Ill.

Reliance—Regulators. General Controls Co., Glendale, Cal.

Remco—Bases. Manley Products Corp., York, Pa.

Renewo—Valves. Lunkenheimer Co., Cincinnati, O.

Renu-Vent—Air filters. American Air Filter Co., Inc., Louisville, Ky.

Research—Belting. Graton & Knight Mfg. Co., Worcester, Mass.

Rex—Chain drives, couplings, nozzles, pillow blocks, pumps. Chain Belt Co., Milwaukee, Wis.

Rex-AC—Pillow blocks, blowers, fans. Air Controls, Inc., Cleveland, O.

Rex-Airate—Roof ventilators, blower wheels. Air Controls, Inc., Cleveland, O.

Rexoil—Burners, heaters. Reif-Rexoil, Inc., Buffalo, N. Y.

Rexvane—Fans, unit heaters. Sturtevant Co., B. F., Boston, Mass.

Rex-Weld—Hose. Chicago Metal Hose Corp., Maywood, Ill.

Rhino—Calking compounds. Pecora Paint Co., Philadelphia, Pa.

Richvar—Radiation. Richmond Radiator Co., Gas Products Div., Uniontown, Pa.

Ridgid—Pipe machines, wrenches, cutters, vises. Ridge Tool Co., Elyria, O.

Rifco—Unions. Rhode Island Fittings Co., Hillsgrove, R. I.

Riheo—Humidifiers. Rhode Island Humidifier & Ventilating Co., Boston, Mass.

Rip-pl—Enamels and lacquers. Hilo Varnish Corp., Brooklyn, N. Y.

Rockaway—Regulators, valves. Kieley & Mueller, Inc., New York, N. Y.

Rocktex—Insulation. Carey Co., Philip, Lockland, Cincinnati, O.

Rocop—Heaters. Rome-Turney Radiator Co., Rome, N. Y.

Rodpax—Packing. National Engineering Products, Inc., Washington, D. C.

Roofvane—Ventilators. Sturtevant Co., B. F., Boston, Mass.

Roof-Vent—Ventilators. Reed Unit-Fans, Inc., New Orleans, La.

Rotameter—Flow meters. Schutte & Koerting Co., Philadelphia, Pa.

Roto Blast—Furnaces. Moncrief Furnace Co., Atlanta, Ga.

Roto-Clone—Dust collectors. American Air Filter Co., Inc., Louisville, Ky.

Rotohood—Uno Ventilator Co., Cliftondale, Mass.

Rotojet—Spray nozzles. Binks Mfg. Co., Chicago, Ill.

Royal—Boilers, water heaters. Hart & Crouse Corp., Utica, N. Y.

Rubalt—Enamels and lacquers. Hague & Co., Inc., Alfred, Brooklyn, N. Y.

Runwell—Packing. Greene, Tweed & Co., New York, N. Y.

Rusco—Insulation. Russell Co., F. C., Cleveland, O.

Rustop—Boiler cleaning compounds, water treatment. Aquatic Chemical Laboratories, Inc., New York, N. Y.

Ryan—Burners, valves. R-S Products Corp., Philadelphia, Pa.

SA—Valves. Lunkenheimer Co., Cincinnati, O.

S-N—Water heaters. Scott-Newcomb, Inc., St. Louis, Mo.

S & P—Burners, governors, preheaters, regulators, strainers, valves. Staples & Pfeiffer, Ltd., San Francisco, Cal.

Sal-Mo—Cement, insulation, packing. Sall Mountain Co., Chicago, Ill.

Sanidaire—Humidifiers. U. S. Air Conditioning Corp., Minneapolis, Minn.

Santrol—Registers. Tuttle & Bailey, Inc., New Britain, Conn.

Satincote — Insulation. Insulite Co., Minneapolis, Minn.

Saunders—Pipe cutters. Erie Tool Works, Erie, Pa.

Scru-peller—Ejectors. Chicago Pump Co., Chicago, Ill.

Sea Lion—Packing. Chicago Belting Co., Chicago, Ill.

Sealdslab — Insulation. Insulite Co., Minneapolis, Minn.

Sealkote—Cement. Keasbey & Mattison Co., Ambler, Pa.

Seal-Less — Compressors. Westinghouse Electric & Mfg. Co., East Springfield, Mass.

Seal Master — Bearings. Stephens-Adamson Mfg. Co., Aurora, Ill.
Seal-Rite—Cement and compounds. Macksons Co., New York, N. Y.
Seigelite — Gaskets. Johns-Manville, New York, N. Y.
Seismo-Dampers—Bases. Korfund Co., Long Island City, N. Y.
Sells—Bearings. Royersford Foundry & Machine Co., Royersford, Pa.
Sensatherm — Thermostats. Mercoid Corp., Chicago, Ill.
Sensitrol—Relays. Weston Electrical Instrument Corp., Newark, N. J.
Service—Packing. Johns-Manville, New York, N. Y.
Sesure—Gages. Yarnall-Waring Co., Philadelphia, Pa.
"78"—Traps. Webster & Co., Warren, Camden, N. J.
Shawco—Bends, joints, headers. Shaw Co., Benjamin F., Wilmington, Del.
Shelby—Tubing. National Tube Co., United States Steel Corp. Sub., Pittsburgh, Pa.
Sentry—Smoke alarms. Boiler Room Equipment, Inc., New York, N. Y.
Shield-Arc — Electrodes, arc welders. Lincoln Electric Co., Cleveland, O.
Shock Pads—Bases and pads. Butterworth, Jr., B. T., New Canaan, Conn.
Silent Air—Fans. Belanger Fan & Blower Co., Detroit, Mich.
Silentvane—Fans. Sturtevant Co., B. F., Boston, Mass.
Sil-Fos—Solder. Handy & Harman, New York, N. Y.
Silicair—Insulation. Western Silicair Products, Inc., Burbank, Cal.
Silverlink—Chain drives. Link-Belt Co., Chicago, Ill.
Silverseal—Packing. Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.
Silverstreak—Chain drive. Link-Belt Co., Chicago, Ill.
Silvertop—Traps. Anderson Co., V. D., The, Cleveland, O.
Simplex—Gages. Viking Pump Co., Cedar Falls, Ia.
Simplex—Pipe vises. Desmond-Stephan Mfg. Co., Urbana, O.
Simplex—Quadrants. Ohio Products Co., Cleveland, O.
Sirocco—Blowers, dust collectors, fans, grilles, unit air conditioners, unit air coolers, unit air humidifiers, air washers. American Blower Corp., Detroit, Mich.
Smoot—Combustion control systems, regulators. Republic Flow Meters Co., Chicago, Ill.
Smoothcote—Insulation. Insulite Co., Minneapolis, Minn.
Sodrin—Boiler and radiator sealing compound. Dole Valve Co., Chicago, Ill.
Softweld—Electrodes. Lincoln Electric Co., Cleveland, O.
Solray—Radiation. Weil-McLain Co., Chicago, Ill.
Sonistat—Gages. American Air Filter Co., Inc., Louisville, Ky.
Sono-O-Seal—Insulation. General Insulating Products Co., Brooklyn, N. Y.
Sovereign—Packing. Darcold Co., Inc., New York, N. Y.
Spatter Film — Electrodes. Lincoln Electric Co., Cleveland, O.
Special '98—Regulators, valves. Kieley & Mueller, Inc., New York, N. Y.
Speedarc—Electrodes. Universal Power Corp., Cleveland, O.
Speed Heater—Unit heaters. Sturtevant Co., B. F., Boston, Mass.
Spider Web—Air filters. Wilson & Co., Chicago, Ill.
Spiralwound—Gaskets. Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.
Spirodome — Spray nozzles. Cooling Tower Co., Inc., The, Div. of the Fluor Corp., Ltd., New York, N. Y.
Spirotallic — Gaskets. Johns-Manville, New York, N. Y.
Spirovane—Fans. Western Blower Co., Seattle, Wash.
Sporlan—Valves. Spoehrer-Lange Co., St. Louis, Mo.
Spraco—Nozzles, separators, strainers, washers. Spray Engineering Co., Somerville, Mass.
Spra-Rite—Nozzles. Binks Mfg. Co., Chicago, Ill.
Stabilfio—Valves. Foxboro Co., Foxboro, Mass.
Stable-Arc—Electrodes, arc welders. Lincoln Electric Co., Cleveland, O.
Stacon—Regulators, valves. Edison, Inc., Thomas A., Edison Electrical Controls Div., West Orange, N. J.
Sta-Cool—Heating and cooling surface. Star Radiator Co., Los Angeles, Cal.
Staidarc—Electrodes. Universal Power Corp., Cleveland, O.
Stainarc—Electrodes. Universal Power Corp., Cleveland, O.
Stainless—Cement and compounds. Grinnell Co., Inc., Providence, R. I.
Stainweld—Electrodes. Lincoln Electric Co., Cleveland, O.
Standard—Humidistats. Spencer Thermostat Co., Attleboro, Mass.
Standard—Pipe cutting machines. Oster Mfg. Co., Cleveland, O.
Standard—Traps. Kieley & Mueller, Inc., New York, N. Y.
Star—Ventilators. Merchant & Evans Co., Philadelphia, Pa.
Statictrol—Pressure and vacuum switches. Automatic Control Co., St. Louis, Mo.
Sterilamp—Lamps. Westinghouse Electric & Mfg. Co., Bloomfield, N. J.
Sterlco—Circulators, controls, eliminators, floats, gages, pumps, strainers, heating systems, traps, valves. Sterling Engineering Co., Milwaukee, Wis.
Stictite—Cement. Refractory & Insulation Corp., New York, N. Y.
Stokerelay—Relays. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Stokol — Stokers. Schwitzer-Cummins Co., Indianapolis, Ind.
Stowe—Stokers. Johnston & Jennings Co., Cleveland, O.
Streamaire—Unit heaters, radiation, cooling surface. Young Radiator Co., Racine, Wis.
Stream-Flow—Valves. Monat Valve & Forge Co., Inc., Pittsburgh, Pa.
Stronghold—Belting. Rhoads & Sons, J. E., Philadelphia, Pa.
Stud-Pak—Insulation. United States Mineral Wool Co., Chicago, Ill.
Sullarc—Electrodes. Universal Power Corp., Cleveland, O.
Sunrad—Radiation. American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Super Air Screws—Fans. Marathon Electric Mfg. Corp., Wausau, Wis.
Super Cold Fin—Cooling surface. Rempe Co., Chicago, Ill.
Supercord—V belts. Browning Mfg. Co., Inc., Maysville, Ky.
Super-deLavaud—Pipe. U. S. Pipe & Foundry Co., Burlington, N. J.
Superector—Wrenches. Williams & Co., J. H., New York, N. Y.
Super-Fan—Fan blades. Norwin Co., Freeport, Ill.
Superheat—Packing, Keasbey & Mattison Co., Ambler, Pa.
Superior—Wrenches. Williams & Co., J. H., New York, N. Y.
Superjustable—Wrenches. Williams & Co., J. H., New York, N. Y.
Superratchet—Ratchet wrenches. Williams & Co., J. H., New York, N. Y.
Superrench—Wrenches. Williams & Co., J. H., New York, N. Y.
Super-S—Gages. Klingerit, Inc., New York, N. Y.
Super Silvertop—Traps. Anderson Co., V. D., The, Cleveland, O.
Supersocket—Wrenches. Williams & Co., J. H., New York, N. Y.
Supertemp — Insulation. Eagle-Picher Lead Co., Cincinnati, O.
Supertherm—Systems. Ross Engineering Corp., J. O., New York, N. Y.
Super-type — Unit heaters. Autovent Fan & Blower Co., Chicago, Ill.
Sure Hot—Heaters, valves. Little Mfg. Co., M. S., Hartford, Conn.
Sure Return — Condensation return pumps. Chicago Pump Co., Chicago, Ill.
Sure Seal — Cement and compounds. Grinnell Co., Inc., Providence, R. I.
Surevent—Valves. Gorton Heating Corp., Cranford, N. J.
Surlock—Registers. Tuttle & Bailey, Inc., New Britain, Conn.
Syphon — Bellows, joints, operators, regulators, valves. Fulton Syphon Co., Knoxville, Tenn.
Syphon—Traps, valves. Webster & Co., Warren, Camden, N. J.
Synchro-Meter—Meters. Bailey Meter Co., Cleveland, O.
Synchrotax—Thermostats. Foxboro Co., Foxboro, Mass.
Synchrotie—Recorders. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Syneretizer—Unit ventilators. Nesbitt, Inc., John J. & Buckeye Blower Co., Philadelphia, Pa.
Syncromaster—Pressure regulators. Mason-Neilan Regulator Co., Boston, Mass.
TE—Compressors. Janette Mfg. Co., Chicago, Ill.
T.T.—Smoke guns. Hill, E. Vernon, Chicago, Ill.
Tabasco — Water heaters. Kewanee Boiler Corp., Kewanee, Ill.
Tag—Humidistats, hygrometers, manometers, meters, psychrometers, recorders, regulators, thermometers, traps, valves. Tagliabue Mfg. Co., C. J., Brooklyn, N. Y.
Tampico—Air filters. Chicago Filter Co., Joliet, Ill.
Tannate—Belting, packing. Rhoads & Sons, J. E., Philadelphia, Pa.
Tanseal—Packing. Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.
Techni-Vane—Vanes. Waterloo Register Co., Waterloo, Ia.
Teksag Colloid—Boiler compounds. American Teksag Products Co., Inc., Mount Vernon, N. Y.
Televisor—Gages. Schutte & Koerting Co., Philadelphia, Pa.
Teltru—Anemometers, gages. Hill, E. Vernon, Chicago, Ill.
Tem-Clock (Electric)—Time switches. Penn Electric Switch Co., Goshen, Ind.
Temcoustic — Insulation. Armstrong Cork Co., Lancaster, Pa.
Temlok—Insulation. Armstrong Cork Co., Lancaster, Pa.
Temperator — Unit air conditioners. Dunham Co., C. A., Chicago, Ill.
TempOstats—Thermostats. D & M Mfg. Co., Midland Park, N. J.
Tempryte — Windows. Truscon Steel Co., Youngstown, O.
Texrope—V-belt drives. Allis - Chalmers Mfg. Co., Milwaukee, Wis.
Therhumiter—Thermometers. Parsons, John R., New York, N. Y.
Thermair—Furnaces, heaters. New York Blower Co., Chicago, Ill.
Thermalfin—Unit coolers. Thermal Co., Inc., Milwaukee, Wis.
Therm-A-Lute — Cement and compounds. Superior Valve & Fittings Co., Pittsburgh, Pa.
Thermidaire—Boilers, furnaces, grilles, heaters, humidifiers. Campbell Heating Co., E. K., Kansas City, Mo.
Thermix—Dust collector. Prat-Daniel Corp., Port Chester, N. Y.
Thermo—Expansion valves. Alco Valve Co., St. Louis, Mo.
Thermofin — Radiation. Grinnell Co., Inc., Providence, R. I.
Thermoflex—Strainers, heating systems, traps, valves. Cashin Co., W. D., Boston, Mass.
Thermoguide—Thermometers. Taylor Instrument Companies, Rochester, N. Y.
Thermoller—Unit heaters. Grinnell Co., Inc., Providence, R. I.
Thermopane—Windows. Libbey-Owens Ford Glass Co., Toledo, O.
Therm-o-tile—Conduit. Porter & Co., Inc., H. W., Newark, N. J.
Thermotrol—Valves. Sterling Engineering Co., Milwaukee, Wis.
Thermovent—Unit ventilators. Nesbitt, Inc., John J., & Buckeye Blower Co., Philadelphia, Pa.
Thor—Drills, pumps. Independent Pneumatic Tool Co., Chicago, Ill.
Thredolets—Fittings. Bonney Forge & Tool Wks., Allentown, Pa.
Thrift—Water heaters. Surface Combustion Corp., Toledo, O.
Throway—Air filters. American Air Filter Co., Inc., Louisville, Ky.
Ticone—Boilers. Titusville Iron Wks. Co., Titusville, Pa.
Tighton—Unions. Standard Union Co., New York, N. Y.

Timercold—Time switches. Mercoid Corp., Chicago, Ill.
Timerelay—Relays. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Timetrol (Manual) — Time switches. Penn Electric Switch Co., Goshen, Ind.
Tiny—Traps. Nason Co., Detroit, Mich.
Tiscot—Boilers. Titusville Iron Wks. Co., Titusville, Pa.
Titan—Traps. Nason Co., Detroit, Mich.
Titeseal—Cement and compounds. Radiator Specialty Co., Charlotte, N. C.
Tom Thumb—Pipe machines. Oster Mfg. Co., Cleveland, O.
Toncan—Pipe, sheets. Republic Steel Corp., Cleveland, O.
Toncanarc—Electrodes. Universal Power Corp., Cleveland, O.
Toolweld—Electrodes. Lincoln Electric Co., Cleveland, O.
Torkfinish—Wrenches. Blackhawk Mfg. Co., Milwaukee, Wis.
Torqometer — Torque indicating wrenches. Snap-On Tools Corp., Kenosha, Wis.
Transite — Pipe, refractories. Johns-Manville, New York, N. Y.
Trans-Lux — Enamels and lacquers. Hilo Varnish Corp., Brooklyn, N. Y.
Transweld—Electrodes. Lincoln Electric Co., Cleveland, O.
Trem-Bar—Insulation. United States Gypsum Co., Chicago, Ill.
Trimo—Cutters, vises, wrenches. Trimont Mfg. Co., Boston, Mass.
Trimo—Cutters. Erie Tool Works, Erie, Pa.
Tripl-Disc — Valves. Rockford Brass Works, Rockford, Ill.
Triple Duty—Boilers. Bass Foundry & Machine Co., Ft. Wayne, Ind.
Tri-Sil—Dampers, registers. Tuttle & Bailey, Inc., New Britain, Conn.
Tritrol—Regulators, switches, thermostats. Marsh Corp., Jas. P., Chicago, Ill.
Triumph—Gaskets. Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.
Triumph—Pipe line filters. Adams Co., R. P., Buffalo, N. Y.
Trojan—Boilers, Burnham Boiler Corp., Irvington, N. Y.
Truflex—Bi-metals. General Plate Co., Attleboro, Mass.
Tuffernell—Cement. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Turbo—Air washers, dehumidifiers, spray nozzles. Bayley Blower Co., Milwaukee, Wis.
Turbo-Aquatherm — Water heaters. Dahlquist Mfg. Co., Inc., Boston, Mass.
Turbo Vane—Fans and blowers. B. F. Sturtevant Co., Boston, Mass.
Turret — Pumps. Yeomans Bros. Co., Chicago, Ill.
Tuway—Strainers. Wright-Austin Co., Detroit, Mich.
20th Century—Bearings. Roller Bearing Co. of America, Trenton, N. J.
Two Way—Dampers. Tuttle & Bailey, Inc., New Britain, Conn.
Tymit—Switches. Tork Clock Co., Inc., Mt. Vernon, N. Y.
Tytecote—Insulation. Specialty Converters, Inc., East Braintree, Mass.
UAC—Unit air conditioners. Burnham Boiler Corp., Irvington, N. Y.
U. F. S.—Clamps. Grinnell Co., Inc., Providence, R. I.
U. S.—Unions. United Superior Union Co., Inc., Brooklyn, N. Y.
USS—Sheets, structural shapes. Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.
U. S. Airco—Air conditioning equipment. U. S. Air Conditioning Corp., Minneapolis, Minn.
U-Loy—Sheets. Republic Steel Corp., Cleveland, O.
Uniblade—Fans, pressure blowers. Autovent Fan & Blower Co., Chicago, Ill.
Unicool—Humidifiers, unit air conditioners, unit air coolers, unit air humidifiers, air washers. Betz Unit Air Cooler Co., Kansas City, Mo.
Uni-fin—Grilles, registers. Barber-Colman Co., Rockford, Ill.
Uni-flo—Air diffusers, dampers, grilles. Barber-Colman Co., Rockford, Ill.
Uniflow—Oil burners. Ace Engineering Co., Chicago, Ill.
Unisorb—Bases and pads, insulation. Felters Co., Inc., Boston, Mass.
Unitaire—Unit air conditioners. Westinghouse Electric & Mfg. Co., East Springfield, Mass.
Unitherm—Unit heaters and coolers. Clarage Fan Co., Kalamazoo, Mich.
Unitrol—Regulators, switches, thermostats. Marsh Tritrol Co., Chicago, Ill.
Universal—Air filters. Hugo Mfg. Co., West Duluth, Minn.
Universal — Packing. Johns-Manville, New York, N. Y.
Universal—Regulators. Dockson Co., C. H., Detroit, Mich.
Utica—Radiation. International Heater Co., Utica, N. Y.
Utility — Compressors. Schramm, Inc., West Chester, Pa.
Utility—Packing. Keasbey & Mattison Co., Ambler, Pa.
Utilus—Fans. Hirschman Co., W. F., Buffalo, N. Y.
Vacu-Draft—Blowers. Muncie Gear Wks., Inc., Muncie, Ind.
Vacuumstat — Regulators, switches. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Valcalox—Damper regulators. Young Regulator Co., Cleveland, O.
Valpit—Unions. Pittsburgh Valve & Fittings Corp., Barberton, O.
Vaporstat—Regulators, switches. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Vari-Pitch—Speed changers. Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Velvet—Cement. Keasbey & Mattison Co., Ambler, Pa.
Vento — Heating surface. American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.
Vent-Rite—Air valves, air eliminators. Anderson Products, Inc., Cambridge, Mass.
Ventura—Fans. American Blower Corp., Detroit, Mich.
Venturafin—Unit heaters. American Blower Corp., Detroit, Mich.
Venturi-Flo—Air diffusers. Barber-Colman Co., Rockford, Ill.
Vibracork—Bases. Armstrong Cork Co., Lancaster, Pa.
Vibrafram—Insulation. Celotex Corp., The, Chicago, Ill.
Vibro-Dampers — Bases. Korfund Co., Long Island City, N. Y.
Vibro Insulators—Bases. Goodrich Co., B. F., Akron, O.
Victor—Steam traps. Wright-Austin Co., Detroit, Mich.
Vistand—Vise stands. Armstrong Mfg. Co., Bridgeport, Conn.
Vitalaire—Air conditioning units. Ice Cooling Appliance Corp., Morrison, Ill.
Vitalloy—Wrenches. Billings & Spencer Co., Hartford, Conn.
Vitra-Carlite—Enamels and lacquers. Hilo Varnish Corp., Brooklyn, N. Y.
V-Meth-L — Refrigerant. Virginia Smelting Co., West Norfolk, Va.
Volcano—Ventilators. Iwan Brothers, South Bend, Ind.
Vortex—Pumps. Lawrence Pump & Engine Co., Lawrence, Mass.
Vulcalock—Fittings, pipe, valves. Goodrich Co., B. F., Akron, O.
Vulcan—Benders, stands, tongs, vises. Williams & Co., J. H., New York, N. Y.
Vulcan—Unions. Rockwood Sprinkler Co., Worcester, Mass.
Vulco — Belts, drives. Gates Rubber Co., Denver, Col.
WHS—Couplings, drives, reducers. Smith, Inc., Winfield H., Springville, N. Y.
W. & McD.—Strainers, valves. Watson & McDaniel Co., Philadelphia, Pa.
W-S—Fittings. Watson-Stillman Co., Roselle, N. J.
Walco-Parmelee—Wrenches. Walworth Co., New York, N. Y.
Wallvane—Fans. Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Walseal — Fittings, valves. Walworth Co., New York, N. Y.
Waltham—Burners. d'Este Co., Julian, Charlestown, Mass.
Walton—Air filters. Research Products Corp., Madison, Wis.
Warco—Valves. Russell & Co., W. A., Bridgeport, Conn.
Ward-O-Vane—Fans. Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Water-Boy—Feeders. Maid-O-Mist, Inc., Chicago, Ill.
Waterfilm—Boilers. Koven & Bro., Inc., L. O., Jersey City, N. J.
Water-Ray-Trola — Heaters. Ray Oil Burner Co., San Francisco, Cal.
Way "Loctor"—Access panels. Walsh Spencer Co., Boston, Mass.
Weaco—Preheaters, thermostats. Warren Electric Appliance Co., Warren, Pa.
Wear-Proof—Pumps. Schneible Co., Claude B., Chicago, Ill.
Wearweld—Electrodes. Lincoln Electric Co., Cleveland, O.
Weathermaker—Unit air conditioners. Carrier Corp., Syracuse, N. Y.
Weatherstat—Thermostats. Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Weatherwood—Insulation. United States Gypsum Co., Chicago, Ill.
Webster-Nesbitt—Unit heaters. Webster & Co., Warren, Camden, N. J.
Webster-Nesbitt — Unit heaters. Nesbitt, Inc., John J., Philadelphia, Pa.
Wedgbelt—V belts and v-belt drives. American Pulley Co., Philadelphia, Pa.
Weldells—Welding fittings. Taylor Forge & Pipe Works, Chicago, Ill.
Weldfast—Welding rod. Revere Copper & Brass, Inc., New York, N. Y.
Weldolets—Fittings. Bonney Forge & Tool Works, Allentown, Pa.
Weldomatic—Arc welders. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Weldotrol—Spot welders. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Westco—Pumps. Micro-Westco, Inc., Bettendorf, Ia.
Whirljet—Spray nozzles. Spraying Systems Co., Chicago, Ill.
Wichita—Condensers, cooling towers. Motor Equipment Co., Wichita, Kans.
Wilco—Bi-metals. Wilson Co., H. A., The, Newark, N. J.
Wilco—Pipe cutting machines. Oster Mfg. Co., Cleveland, O.
Willie Williams — Pipe cutting and threading machines. Oster Mfg. Co., Cleveland, O.
Windowstat—Condensation control. Friez & Sons, Julien P., Baltimore, Md.
Wind-O-Vane—Propeller fans. Sturtevant Co., B. F., Boston, Mass.
Wind-O-Vent—Window ventilator and filter units. Reed Unit-Fans, Inc., New Orleans, La.
Wing-Scruplex — Fans, ventilators. Wing Mfg. Co., L. J., New York, N. Y.
Winner—Registers. Auer Register Co., Cleveland, O.
Wintermaster—Unit air humidifiers. International Boiler Works, Co., East Stroudsburg, Pa.
Wisco—Grilles. Wickwire Spencer Steel Co., New York, N. Y.
Witch—Hangers, protectors. Carpenter & Paterson, Inc., East Boston, Mass.
Wolverine—Collectors, fans, ventilators, washers. Belanger Fan & Blower Co., Detroit, Mich.
Wonder—Benders. American Pipe Bending Machine Co., Inc., Boston, Mass.
Wrigley—Bolts. Chicago Expansion Bolt Co., Chicago, Ill.
X-L — Gaskets, packing. Excelsior Leather Washer Co., Rockford, Ill.
Xacto—Meters. Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Xit—Ventilators. Iona Ventilator Co., Inc., Philadelphia, Pa.
Yager—Solder. Benson Co., Inc., Alex R., Hudson, N. Y.
Yarway—Expansion joints, nozzles, traps, valves. Yarnall-Waring Co., Philadelphia, Pa.
Yello-Jacket—Heating boilers. Burnham Boiler Corp., Irvington, N. Y.
Yorkaire—Unit air coolers. York Ice Machinery Corp., York, Pa.
Zinegrip — Sheets. American Rolling Mill Co., Middletown, O.

DIRECTORY SECTION

HEATING, PIPING AND AIR CONDITIONING EQUIPMENT FOR INDUSTRY AND LARGE BUILDINGS

PART 3—MANUFACTURERS' ADDRESSES

A

Accurate Mfg. Works, 2336-38 Milwaukee Ave., Chicago, Ill.
Accurate Metal Weather Strip Co., 216 E. 26th St., New York, N. Y.
Ace Engineering Co., 1735 W. 31st St., Chicago, Ill.
Acer & Whedon, Medina, N. Y.
Acheson Mfg. Co., Braddock P. O., Rankin, Pa.
Acme Asbestos Covering & Flooring Co., 218 N. Elizabeth St., Chicago, Ill.
Acme Electric Welder Co., 5619 Pacific Blvd., Huntington Park, Cal.
Acme Heating & Ventilating Co., Inc., 4224 Lowe Ave., Chicago, Ill.
Acme Industries, Inc., Cor. Mechanic and Ganson Sts., Jackson, Mich.
Acme Refining Co., The, W. 56th & W. & L. E. Ry., Cleveland, O.
Acme Tin Plate & Roofing Supply Co., 10th and York Sts., Philadelphia, Pa.
Acorn Refining Co., 8001 Franklin Ave., Cleveland, O.
Adam Electric Co., Frank, 3650 Windsor St., St. Louis, Mo.
Adams Co., The, E. 4th St., Dubuque, Ia.
Adams Co., R. P., 55 Chicago St., Buffalo, N. Y.
Adams Mfg. Co., J. D., 217 S. Belmont Ave., Indianapolis, Ind.
Ad-Lee Co., Inc., 825 S. Wabash Ave., Chicago, Ill.
Advance Aluminum Castings Corp., 2742 W. 36th Pl., Chicago, Ill.
Advance Electric Co., 1260 W. Second St., Los Angeles, Cal.
Advance Fan & Blower Co., 3428 Bagley, Detroit, Mich.
Advance Insulating Co., Magee Bldg., Pittsburgh, Pa.
Advanced Refrigerating Systems Co., 33rd and Arch Sts., Philadelphia, Pa.
Aeco Packing Products Co., 215 W. Illinois St., Chicago, Ill.
Aeolus Dickinson Co., 3320 S. Artesian Ave., Chicago, Ill.
●Aerofin Corp., 410 S. Geddes St., Syracuse, N. Y.
Aerovent Fan Co., 710 E. Ash St., Piqua, O.
Agnew Electric Welder Co., Milford, Mich.
Ahlberg Bearing Co., 3025 W. 47th St., Chicago, Ill.
Air Conditioning Utilities Co., 8 W. 40th St., New York, N. Y.
Air Control Products, Inc., Glades St. and Larch, Muskegon, Mich.
●Air Controls, Inc., 9205 Detroit Ave., Cleveland, O.
●Air Filter Engineering Co., 2236 S. Wabash Ave., Chicago, Ill.
Air Filter Engineering Co., Omaha, Neb.
Air Reduction Sales Co., 60 E. 42nd St., New York, N. Y.
●Air & Refrigeration Corp., 11 W. 42nd St., New York, N. Y.
Aircraft Mfg. Co., 418 E. First St., Dayton, O.
Aire-Foile Fan & Blower Co., 4737 W. Vernor Highway, Detroit, Mich.
Airgard Mfg. Co., 609 N. La Salle St., Chicago, Ill.
Airmaster Corp., 4317 Ravenswood Ave., Chicago, Ill.
●Air-Maze Corp., 5200 Harvard Ave., Cleveland, O.
Airo Supply Co., 2726 N. Ashland Ave., Chicago, Ill.
Air-O-Cel Industries, Inc., 11616 Cloverdale Ave., Detroit, Mich.
Air-O-Line Co., The, 2118 Griffin St., Dallas, Tex.
Air-Stream Filter Corp., 2100 Washington Ave., St. Louis, Mo.
Airtemp, Div. of Chrysler Corp., Leo St., Dayton, O.
●Airtherm Mfg. Co., 1478 S. Vandeventer Ave., St. Louis, Mo.
Ajax Flexible Coupling Co., Westfield, N. Y.
Akron Metallic Gasket Co., 155 N. Union, Akron, O.
Akwa Heaters, Inc., 1955 Park Ave., New York, N. Y.
Alabama Pipe Co., Anniston, Ala.
●Alco Valve Co., 2628 Big Bend Blvd., St. Louis, Mo.
Aldrich Pump Co., 4 Pine St., Allentown, Pa.
Alexander Bros., 406 N. 3rd, Philadelphia, Pa.
Alfol Insulation Co., Inc., 155 E. 44th St., New York, N. Y.
All Metal Weatherstrip Co., 229 W. Illinois St., Chicago, Ill.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Allen Billmyre Corp., 132 Water St., South Norwalk, Conn.
●Allen-Bradley Co., 1335 S. First St., Milwaukee, Wis.
Allen Corp., 9767 Erwin Ave., Detroit, Mich.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Allis Co., Louis, The, 427 E. Stewart St., Milwaukee, Wis.
Alloy Steel Products Co., 1000 W. Elizabeth Ave., Linden, N. J.
Allpax Co., Inc., Mamaroneck, N. Y.
Alpha Metal & Rolling Mills, Inc., 363 Hudson Ave., Brooklyn, N. Y.
Alten's Foundry & Machine Works, 226 W. Wheeling St., Lancaster, O.
Alter-Arc Mfg. Co., 209 B St., Lawton, Okla.
Alton Mineral Wool Insulation Co., P. O. Box 268, Alton, Ill.
Aluminum Aircell Insulation Co., Curtis Bldg., Detroit, Mich.
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
American Agile Corp., 5806 Hough Ave., Cleveland, O.
●American Air Filter Co., Inc., 107 Central Ave., Louisville, Ky.
American Blower Corp., 6000 Russell St., Detroit, Mich.
American Bosch Corp., 3664 Main St., Springfield, Mass.
●American Brass Co., 414 Meadow St., Waterbury, Conn.
American Cast Iron Pipe Co., 2930 N. 16th St., Birmingham, Ala.
American Coal Burner Co., 155 E. Superior St., Chicago, Ill.
American Coils, Inc., 25-27 Lexington St., Newark, N. J.
American Coolair Corp., 3604 Mayflower St., Jacksonville, Fla.
American Cooling Tower Co., 2710 McGee St., Kansas City, Mo.
●American District Steam Co., Bryant St., North Tonawanda, N. Y.
American District Telegraph Co., 155 E. 6th Ave., New York, N. Y.
American Engineering Co., Aramingo Ave. and Cumberland St., Philadelphia, Pa.
American Flange & Mfg. Co., Inc., 1901 R. C. A. Bldg., New York, N. Y.
American Flexible Coupling Co., 1801 Pittsburgh Ave., Erie, Pa.
American Foundry Equipment Co., 619 Byrkit St., Mishawaka, Ind.
American Foundry & Furnace Co., Washington St. at McClun, Bloomington, Ill.
American Hair & Felt Co., 1828 Merchandise Mart, Chicago, Ill.
American Hammered Piston Ring Div., Koppers Co., Bush and Hamburg Sts., Baltimore, Md.
American Hard Rubber Co., 11 Mercer St., New York, N. Y.
American Hydrozone Co., Inc., 10 E. 40th St., New York, N. Y.
American Injector Co., 1481-14th St., Detroit, Mich.
American Instrument Co., Silver Spring, Md.
American-Larson Ventilating Co., 1004 Keystone Bank Bldg., Pittsburgh, Pa.
American Locomotive Co., Alco Products Div., 30 Church St., New York, N. Y.
American Locomotive Co., Diesel Engine Div., Auburn, N. Y.
American Manganese Bronze Co., Rhawn & Hegerman Sts., Philadelphia, Pa.
American-Marsh Pumps, Inc., 60 Capital Ave., N. E., Battle Creek, Mich.
●American Metal Hose Branch, American Brass Co., 67 Jewelry St., Waterbury, Conn.
American Metal Weather Strip Co., 144 N. Division Ave., Grand Rapids, Mich.
American Meter Co., Inc., 105 W. 40th St., New York, N. Y.
American Moistening Co., 260 W. Exchange St., Providence, R. I.
American Nickeloid Co., 113 Second St., Peru, Ill.
American Pipe Bending Machine Co., Inc., 37 Pearl St., Boston, Mass.
American Pipe Tool Co., 4856 W. Kinzie St., Chicago, Ill.
American Pulley Co., 4200 Wissahickon Ave., Philadelphia, Pa.
American Radiator & Standard Sanitary Corp., Bessemer Bldg., Pittsburgh, Pa.
●American Rolling Mill Co., The, 703 Curtis St., Middletown, O.
American Sheet Metal Works, 331 N. Alexander, New Orleans, La.
American Solder & Flux Co., Wayne Ave. and Berkley St., Philadelphia, Pa.
American Steel & Wire Co., Rockefeller Bldg., Cleveland, O.
American Teksag Products Co., Inc., 395 N. MacQuesten Pkwy., Mt. Vernon, N. Y.
American Thermometer Co., 2907 Clark Ave., St. Louis, Mo.
American Warming & Ventilating Co., 1017-1021 Summit St., Toledo, O.
American Well Wks., 100 N. Broadway, Aurora, Ill.
American Zinc Products Co., Greencastle, Ind.
Ames Co., W. R., 150 Hooper St., San Francisco, Cal.
Ames Iron Works, Division of Pierce Butler Radiator Corp., Oswego, N. Y.
Amirton Co., 60 E. 42nd St., New York, N. Y.
Anchor Packing Co., 401 N. Broad St., Philadelphia, Pa.
Anchor Stove & Range Co., Third & Culbertson Sts., New Albany, Ind.
●Anderson Co., V. D., The, 1949 W. 96th St., Cleveland, O.

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Anderson Engine & Foundry Co., Anderson, Ind.
Anderson Mfg. Co., 511 Third, Des Moines, Ia.
Anderson Products, Inc., 17 Tudor St., Cambridge, Mass.
Andrews Lead Co., 26-36 Greenpoint Ave., Long Island City, N. Y.
Anemostat Corp. of America, 10 E. 39th St., New York, N. Y.
Anetsberger Bros., 3505 Elston Ave., Chicago, Ill.
Annis Air Filters, 1515 Gardena St., Glendale, Cal.
Ansul Chemical Co., Marinette, Wis.
Apex Rotarex Corp., 1070 E. 152nd St., Cleveland, O.
Apollo Steel Co., 609 Warren Ave., Apollo, Pa.
Aqua-Sorb Co., 21 S. 16th St., East Orange, N. J.
Aquatic Chemical Laboratories, Inc., 118 E. 28th St., New York, N. Y.
Arcos Corp., 401 N. Broad St., Philadelphia, Pa.
Arcweld Mfg. Co., Inc., 3469 Third Ave., W., Seattle, Wash.
Arex Co., 333 N. Michigan Ave., Chicago, Ill.
Armour Ammonia Works, 1355 W. 31st St., Chicago, Ill.
Armstrong-Blum Mfg. Co., 5700 Bloomingdale Rd., Chicago, Ill.
Armstrong Bros. Tool Co., 317-357 N. Francisco Ave., Chicago, Ill.
Armstrong Co., The, Post Ave. and South St., Detroit, Mich.
●Armstrong Cork Co., 994 Concord St., Lancaster, Pa.
●Armstrong Machine Wks., 874 Maple St., Three Rivers, Mich.
Armstrong Mfg. Co., 303 Knowlton St., Bridgeport, Conn.
Arrow-Hart & Hegeman Elect. Co., 103 Hawthorn St., Hartford, Conn.
Ashton Valve Co., 161-1st St., Cambridge, Mass.
Askania Regulator Co., 1605 S. Michigan Ave., Chicago, Ill.
Atlantic Metal Hose Co., Inc., 123 W. 64th St., New York, N. Y.
Atlantic Valve & Pump Co., 4045 W. Kinzie St., Chicago, Ill.
Atlas Asbestos Co., Ltd., 110 McGill St., Montreal, Que., Canada.
Atlas Chemical Co., Marietta, O.
Atlas Heating & Ventilating Co., Ltd., 557 Fourth St., San Francisco, Cal.
Atlas Valve Co., Inc., 282 South St., Newark, N. J.
Auburn Foundry Inc., Stoker Div., Auburn, Ind.
Auditorium Conditioning Corp., 17 E. 42nd St., New York, N. Y.
●Auer Register Co., 3608 Payne Ave., Cleveland, O.
Aurora Pump Co., 619 Loucks St., Aurora, Ill.
Austin-Mason Co., 15 Park Row, New York, N. Y.
●Au-Temp-Co Corp., 1 Park Ave., New York, N. Y.
Autoforce Ventilating System, 53 Devonshire St., Boston, Mass.
Automatic Control Co., 2590 University Ave., St. Paul, Minn.
Automatic Gas Steam Radiator Co., 446 Brushton Ave., Pittsburgh, Pa.
●Automatic Products Co., 2460 N. 32nd St., Milwaukee, Wis.
Automatic Pump & Softener Corp., 1907 Kishwaukee St., Rockford, Ill.
Automatic Stoker Corp., 2427 W. North Ave., Milwaukee, Wis.
Automatic Switch Co., 41 E. 11th St., New York, N. Y.
●Automatic Temperature Control Co., Inc., 33 E. Logan St., Philadelphia, Pa.
Automotive Maintenance Machinery Co., North Chicago, Ill.
●Autovent Fan & Blower Co., 1811-27 N. Kostner Ave., Chicago, Ill.
Azor Corp., Newark, N. J.

B

Babcock & Wilcox Co., 85 Liberty St., New York, N. Y.
Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh, Pa.
Bache & Co., Semon, Greenwich & Morton Sts., New York, N. Y.
●Badger & Sons Co., E. B., 75 Pitts St., Boston, Mass.
Badger Fire Extinguisher Co., 31 St. James Ave., Boston, Mass.
Baer Bros., 438 W. 37th St., New York, N. Y.
Bahnson Co., R. J., Reynolds Bldg., Winston-Salem, N. C.
Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, O.
●Baker Ice Machine Co., Inc., 1508 Evans St., Omaha, Nebr.
Baldor Electric Co., 4353 Duncan Ave., St. Louis, Mo.
Baldwin-Hill Co., 527 Klagg Ave., Trenton, N. J.
Ballantyne Co., 222 N. 16th St., Omaha, Nebr.
Balloffet Dies and Nozzle Co., Inc., 45-51 Adams St., Guttenberg, N. J.
Barber Asphalt Corp., Barber, N. J.
●Barber-Colman Co., 225 Loomis St., Rockford, Ill.
Barber Gas Burner Co., 3704 Superior Ave., Cleveland, O.
Barclay, Inc., Robert, 128 N. Peoria St., Chicago, Ill.
Barco Mfg. Co., 1801 Winnemac Ave., Chicago, Ill.
Bardco Corp. of America, 6670 Lexington Ave., Los Angeles, Cal.
Barium Stainless Steel Corp., 1502 Allen Ave., S. E., Canton, O.
Barland Weatherstrip Material Co., 5600 Curtis Ave., Cleveland, O.
Barnes Co., W. F. & John, Rockford, Ill.
Barnes & Jones, Inc., 128 Brookside Ave., Jamaica Plain, Boston, Mass.
Barnes Tool Co., The, 150 Brewery St., New Haven, Conn.
Barrett Co., The, 40 Rector St., New York, N. Y.
Barrett, Haentjens & Co., Hazleton, Pa.
Barrett Machine Co., 912-916 Behan St., N. S., Pittsburgh, Pa.
Bartlett Hayward Co., 200 Scott St., Baltimore, Md.
Bartlett Mfg. Co., 3003 E. Grand Blvd., Detroit, Mich.
Bass Foundry & Machine Co., 1602-1734 Hanna St., Ft. Wayne, Ind.
Bastian-Blessing Co., 240 E. Ontario St., Chicago, Ill.
Bath & Co., Cyril, Cleveland, O.
Bausch & Lomb Optical Co., 635 St. Paul St., Rochester, N. Y.
Bayer Co., 4030 Chouteau Ave., St. Louis, Mo.
Bayley Blower Co., 1817 S. 66th St., Milwaukee, Wis.
Beach-Russ Co., 60A Church St., New York, N. Y.
Beacon-Morris Corp., 702 Beacon St., Boston, Mass.
Bearings Co. of America, 501 Harrisburg Ave., Lancaster, Pa.
Beaton & Cadwell Mfg. Co., 185 Main St., New Britain, Conn.
Beaton & Corbin Mfg. Co., Southington, Conn.
Beatty Machine & Mfg. Co., 934 150th St., Hammond, Ind.
Beaver Pipe Tools, Inc., Keeney Ave., Warren, O.
Beckley Perforating Co., 315 North Ave., Garwood, N. J.
Belanger Fan & Blower Co., 1230 18th St., Detroit, Mich.
Belco Exhaust Fan Mfg. Co., 3810 Olive St., St. Louis, Mo.
Belfield Co., H., 435 N. Broad St., Philadelphia, Pa.
Belknap Mfg. Co., 800 Union Ave., Bridgeport, Conn.
●Bell & Gossett Co., 3000 Wallace St., Chicago, Ill.
Belmont Packing & Rubber Co., Butler & Sepviva Sts., Philadelphia, Pa.
Belmont Smelting & Refining Wks., Inc., 349 Belmont Ave., Brooklyn, N. Y.
Bender Warrick Corp., 131 Pierce, Birmingham, Mich.
Benjamin Air Rifle Co., 1527 S. 8th St., St. Louis, Mo.
Benjamin Electric Mfg. Co., Des Plaines, Ill.
Bennett Co., 1109 Harney St., Omaha, Nebr.
Benson Co., Inc., Alex R., 1040 Bay Rd., So. Hudson, N. Y.
Berger Bros. Co., 229-237 Arch St., Philadelphia, Pa.
Berger Mfg. Div., Republic Steel Corp., 1038 Belden Ave., Canton, O.
Berns Specialty Co., 1015 Lake St., Chicago, Ill.
Bernz Co., Inc., Otto, 280 Lyell Ave., Rochester, N. Y.
Berry, Jr., & Co., Inc., F. E., Everett, Mass.
Bertsch & Co., Inc., Church St., Cambridge City, Ind.
Best Register Co., 2005 W. Oklahoma Ave., Milwaukee, Wis.
Bethlehem Foundry & Machine Co., W. Second St., Bethlehem, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Betz Air Conditioning Corp., 1820 Wyandotte St., Kansas City, Mo.
Betz Corp., 460 State St., Hammond, Ind.
Beverly Throatless Shear Co., 3009 W. 110th Pl., Chicago, Ill.
Bigelow Co., 92 River St., New Haven, Conn.
Biggs Boiler Wks. Co., Case Ave. & B. & O. R. R., E. Akron, O.
Bignall & Keeler Machine Wks., Edwardsville, Ill.
Billings & Spencer Co., 1 Laurel St., Hartford, Conn.
Binkley Mfg. Co., Warrenton, Mo.
Binks Mfg. Co., 3114-40 Carroll Ave., Chicago, Ill.
Bird-Archer Co., 90 West St., New York, N. Y.
●Bishop & Babcock Mfg. Co., 4901 Hamilton Ave., Cleveland, O.
Black & Decker Mfg. Co., Pennsylvania Ave., Towson, Md.
Blackhawk Mfg. Co., 5325 W. Rogers St., Milwaukee, Wis.
Blackmer Pump Co., 1809 Century Ave., S. W., Grand Rapids, Mich.
Blaisdell Compressor Co., 227 Fulton St., New York, N. Y.
Bliss Co., E. W., 1420 Hastings St., Toledo, O.
Blocksom & Co., E. 5th St., Michigan City, Ind.
Blood Brothers, Allegan, Mich.
Blower Application Co., 918 N. Fourth St., Milwaukee, Wis.
Blue Seal Chemical Co., 177 Westfield Ave., W., Roselle Park, N. J.
Bluffton Mfg. Co., The, 433 W. Main Cross St., Findlay, O.
Bodine Electric Co., 2254 W. Ohio St., Chicago, Ill.
Boester, Carl F., 101 E. Essex—Kirkwood, St. Louis, Mo.
Bohn Aluminum & Brass Corp., 2306 Franklin St., Detroit, Mich.
Boiler Room Equipment, Inc., 45 W. 45th St., New York, N. Y.
Bonney Forge & Tool Wks., Tilghman St. & Meadow St., Allentown, Pa.
Bordo Co., Inc., L. J., 115 New St., Glenside, Pa.
Boston Auto Gage Co., 70 West St., Pittsfield, Mass.
Boston Gear Works, Inc., North Quincy, Mass.
Boston Woven Hose & Rubber Co., Broadway, Cambridge, Mass.
Bowser & Co., Inc., S. F., 1302 E. Creighton Ave., Fort Wayne, Ind.
Boylston Steam Specialty Co., 116-122 W. Illinois St., Chicago, Ill.
Bremil Mfg. Co., Box 1030, Erie, Pa.
Bridgeport Brass Co., E. Main St., Bridgeport, Conn.
Bridgeport Thermostat Co., Connecticut Ave., Bridgeport, Conn.
Bristol Co., Platts Bridge, Waterbury, Conn.
Brooke Engineering Co., Inc., 4517 Wayne Ave., Philadelphia, Pa.
Bros Boiler & Mfg. Co., Wm., Nicollet Island, Minneapolis, Minn.
Brown-Brockmeyer Co., Inc., 1098 Smithville Rd., Dayton, O.
Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., 4534 Wayne Ave., Philadelphia, Pa.
Brownell Co., 300 N. Findlay St., Dayton, O.
Browning Mfg. Co., Inc., 1940 Browning Blvd., Maysville, Ky.
Brundage Co., 514 N. Park St., Kalamazoo, Mich.
Brunner Mfg. Co., 1821 E. Broad St., Utica, N. Y.
Bryan Steam Corp., P. O. Box 337, Peru, Ind.
Bryant Heater Co., The, 17825 St. Clair Ave., Cleveland, O.
Bubar, Hudson H., 15 Park Row, New York, N. Y.
Buda Co., Harvey, Ill.
●Buffalo Forge Co., 171 Mortimer St., Buffalo, N. Y.
Buffalo Meter Co., 2917 Main St., Buffalo, N. Y.
●Buffalo Pumps, Inc., 171 Mortimer St., Buffalo, N. Y.
Buffalo Tank Co., Arlington, Staten Island, N. Y.

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Builders Iron Foundry, 9 Codding St., Providence, R. I.
●Bullard Co., The, 286 Canfield Ave., Bridgeport, Conn.
Bundy Steam Trap Co., Nashua, N. H.
Bundy Tubing Co., 10951 Hern, Detroit, Mich.
Burdett Mfg. Co., 19 N. Loomis St., Chicago, Ill.
Burgess Battery Co., 500 W. Huron St., Chicago, Ill.
Burhorn Co., Edwin, 1 Newark St., Hoboken, N. J.
Burke Electric Co., 1201 W. 12th St., Erie, Pa.
Burke Stoker & Mfg. Co., 921 W. 19th St., Chicago, Ill.
Burling Instrument Co., 4 Belmont Ave., Newark, N. J.
●Burnham Boiler Corp., Main St., Irvington, N. Y.
Burnham Stoker Co., 505 Columbia St., Vancouver, Wash.
Burnley Battery & Mfg. Co., Clay St., North East, Pa.
Burrowes Corp., 70 Free St., Portland, Me.
Burrows Mfg. Co., F. A., 1638 E. Market St., York, Pa.
Burt Mfg. Co., 635 Main St., Akron, O.
Bury Compressor Co., 18th & Cascade Sts., Erie, Pa.
Bush Mfg. Co., 100 Wellington St., Hartford, Conn.
Butler Mfg. Co., 13th & Eastern Ave., Kansas City, Mo.
Butler Street Foundry & Iron Co., 3422 Normal Ave., Chicago, Ill.
Butterworth, B. T., Jr., New Canaan, Conn.
●Byers Co., A. M., Clark Bldg., Pittsburgh, Pa.
Byron Jackson Co., 2150 E. Slauson Ave., Los Angeles, Cal.

C

Cabot, Inc., Samuel, 141 Milk St., Boston, Mass.
Calbar Paint & Varnish Co., 2612-26 N. Martha St., Philadelphia, Pa.
Caldwell, Farley M., 521 W. Berry St., Fort Wayne, Ind.
Caldwell Co., W. E., 2120 Brook St., Louisville, Ky.
California Cornice, Steel & Supply Corp., 1620 N. Spring St., Los Angeles, Cal.
Callahan Can Machine Co., Inc., 80 Richard St., Brooklyn, N. Y.
Caloroil Burner Corp., 1477 Park St., Hartford, Conn.
Campbell Heating Co., E. K., 2445 Charlotte St., Kansas City, Mo.
Campbell Heating Co., 31st & Dean, Des Moines, Ia.
Canatsey Electric Mfg. Co., 620 Wyandotte St., Kansas City, Mo.
Canton Stoker Corp., 407 Andrews Place, S. W., Canton, O.
Canvas Products Co., 1236 S. 7th St., St. Louis, Mo.
Capitol Brass Division, Bohn Aluminum & Brass Corp., 2306 Franklin St., Detroit, Mich.
Carbide & Carbon Chemicals Corp., 30 E. 42nd St., New York, N. Y.
Carbo-Oxygen Co., Benedum-Trees Bldg., Pittsburgh, Pa.
●Carey Co., Philip, Wayne Ave., Lockland, Cincinnati, O.
Carling Turbine Blower Co., 25 St. John's Rd., Worcester, Mass.
●Carnegie-Illinois Steel Corp., Carnegie Bldg., Pittsburgh, Pa.
Carnes, Inc., John R., Greenlawn Ave. & Erie R. R., Lima, O.
Carpenter & Co., Geo. B., 440 N. Wells St., Chicago, Ill.
Carpenter & Paterson, Inc., 1190 Bennington St., East Boston, Mass.
Carpenter Steel Co., Reading, Pa.
●Carrier Corp., 302 S. Geddes St., Syracuse, N. Y.
Carty & Moore Engineering Co., 511 W. Larned St., Detroit, Mich.
Case & Son Mfg. Co., W. A., 33 Main St., Buffalo, N. Y.
●Cash Co., A. W., P. O. Box 135, Decatur, Ill.
Cash Universal Regulator Co., Marshalltown, Ia.
Cashin Co., W. D., 69 A St., Boston, Mass.
Caterpillar Tractor Co., 600 W. Washington St., Peoria, Ill.
Celotex Corp., The, 919 N. Michigan Ave., Chicago, Ill.
Central Brass Mfg. Co., 2950 E. 55th St., Cleveland, O.
Central Die Casting & Mfg. Co., Inc., 2935 W. 47th St., Chicago, Ill.
Central Forging Co., Catawissa, Pa.
Central Foundry Co., 386 Fourth Ave., New York, N. Y.
Central Radiator Co., 386 Fourth Ave., New York, N. Y.
Central Station Steam Co., 2910 E. Woodbridge St., Detroit, Mich.
Central Tube Co., First National Bank Bldg., Pittsburgh, Pa.
Central Valve Mfg. Co., 255 E. 95th St., Chicago, Ill.
Central Wire & Iron Works, 621 E. Locust St., Des Moines, Ia.
Centrifix Corp., 3029 Prospect Ave., Cleveland, O.
●Century Electric Co., 1806 Pine St., St. Louis, Mo.
Century Engineering Corp., 401-431 3rd St., S. E., Cedar Rapids, Ia.
Century Fan & Ventilator Co., 314 E. 39th St., New York, N. Y.
Certain-teed Products Corp., 100 E. 42nd St., New York, N. Y.
Certified Flexible Couplings, Inc., 122 E. 42nd St., New York, N. Y.
Chace Valve Co., W. M., 1606 Beard Ave., Detroit, Mich.
Chain Belt Co., 1644 W. Bruce, Milwaukee, Wis.
Chalmers Oil Burner Co., 1234 Central Ave., Minneapolis, Minn.
Chamberlin Metal Weather Strip Co., 1254 La Brosse St., Detroit, Mich.
Champion Blower & Forge Co., Harrisburg Ave. and Charlotte St., Lancaster, Pa.
Champion Furnace Pipe Co., 918 S. Adams St., Peoria, Ill.
Champion Machine & Forging Co., 3678 E. 78th St., Cleveland, O.
Chandler Co., 804 First Ave., N. W., Cedar Rapids, Ia.
Chaplin-Fulton Mfg. Co., 28-40 Penn Ave., Pittsburgh, Pa.
Chapman Valve Mfg. Co., The, Indian Orchard, Mass.
Char-Gale Mfg. Co., 3127 Hiawatha Ave., Minneapolis, Minn.
Chase Brass & Copper Co., Inc., 236 Grand St., Waterbury, Conn.
Chelsea Fan & Blower Co., 370 W. 15th St., New York, N. Y.
Chelsea Metal Stamping Co., 95 8th Ave., New York, N. Y.
Cheney Co., Architects' Bldg., Philadelphia, Pa.
Chicago Belting Co., 113-125 N. Green St., Chicago, Ill.
Chicago Bridge & Iron Co., 37 W. Van Buren St., Chicago, Ill.
Chicago Die Casting Mfg. Co., 2515 W. Monroe St., Chicago, Ill.
Chicago Expansion Bolt Co., 126 S. Clinton St., Chicago, Ill.
Chicago Filter Co., Joliet, Ill.
Chicago Fire Brick Co., 1467 N. Elston Ave., Chicago, Ill.
Chicago Furnace Supply Co., 1278 Clybourn Ave., Chicago, Ill.
Chicago Metal Hose Corp., Maywood, Ill.
Chicago Metal Mfg. Co., 3724 S. Rockwell St., Chicago, Ill.
Chicago Nipple Mfg. Co., 1966 Southport Ave., Chicago, Ill.
Chicago Perforating Co., 2445 W. 24th Pl., Chicago, Ill.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Chicago Pump Co., 2336 Wolfram St., Chicago, Ill.
Chicago Specialty Mfg. Co., 332 N. Western Ave., Chicago, Ill.
Chicago-Wilcox Mfg. Co., E. 77th St. and Anthony Ave., Chicago, Ill.
Chisholm Co., Allen E., 2640 E. Burnside St., Portland, Ore.
Cincinnati Mfg. Co., Gest and Evans Sts., Cincinnati, O.
Cincinnati Shaper Co., Hopple, Garrard & Elam, Cincinnati, O.
Cincinnati Sheet Metal & Roofing Co., 230 E. Front St., Cincinnati, O.
Circulators & Devices Mfg. Corp., 100 Prince St., New York, N. Y.
Cissell Mfg. Co., W. M., 831 S. First St., Louisville, Ky.
●Clarage Fan Co., Porter St., Kalamazoo, Mich.
Clark Bros. Bolt Co., Millidale, Conn.
Clark Controller Co., 1146 E. 152nd St., Cleveland, O.
Clark Dust Control Co., 210 N. Mozart St., Chicago, Ill.
Clark Jr., Electric Co., Jas., 600 Bergman St., Louisville, Ky.
Clauss Shear Co., Fremont, O.
Clay Equipment Corp., Cedar Falls, Ia.
Clayton & Lambert Mfg. Co., 11111 French Rd., Detroit, Mich.
Cleaver-Brooks Co., 3112 W. Center St., Milwaukee, Wis.
Clees Valve & Engineering Co., 90 West St., New York, N. Y.
Cleghorn Co., 86 Broad St., Boston, Mass.
Cleveland Punch & Shear Works Co., E. 40th and St. Clair Ave., Cleveland, O.
●Clifford Mfg. Co., 564 E. First St., Boston, Mass.
Clinton Metallic Paint Co., P. O. Box 278, Clinton, N. Y.
Clizbe Bros. Mfg. Co., Plymouth, Ind.
Clow & Sons, James B., 201-299 N. Talmon Ave., Chicago, Ill.
●Cochrane Corp., 3161 N. 17th St., Philadelphia Pa.
Coe Mfg. Co., Bank St., Painesville, O.
Cohoes Rolling Mill Co., Canvass and Cortland Sts., Cohoes, N. Y.
Cole-Sullivan Engineering Co., 1316 Third St., N., Minneapolis, Minn.
Colebrook & Sons, Inc., W. H., 246 Walton St., Syracuse, N. Y.
Colonial Alloys Co., Specialties Div., E. Somerset, Trenton Ave and Reading R. R., Philadelphia, Pa.
Columbia Radiator Co., 3400 Walnut St., McKeesport, Pa.
●Columbia Steel Co. (Sub. United States Steel Corp.), Russ Bldg., 235 Montgomery St., San Francisco, Cal.
Columbian Steel Tank Co., 1509 W. 12th St., Kansas City, Mo.
Columbus Heating & Ventilating Co., 182 N. Yale Ave., Columbus, O.
Columbus Metal Products, Inc., 767 N. 4th St., Columbus, O.
Columbus Steam Pump Wks. Co., 724 W. Gay St., Columbus, O.
Combination Boiler Co., Benton Harbor, Mich.
Combustion Engineering Co., Inc., 200 Madison Ave., New York, N. Y.
Commodore Heaters Corp., 11 W. 42nd St., New York, N. Y.
Commonwealth Brass Corp., 5781-5835 Commonwealth Ave., Detroit, Mich.
Commonwealth Mfg. Co., 4208 Davis Lane, Cincinnati, O.
Conditionaire Unit Co., 2821 Montrose Ave., Chicago, Ill.
Conneaut Packing Co., Conneaut, O.
Connery Construction Co., 2nd and Luzerne Sts., Philadelphia, Pa.
Connor Engineering Corp., W. B., Dorex Air Conditioning Div., 114 E. 32nd St., New York, N. Y.
Continental Diamond Fibre Co., Newark, Del.
Continental Electric Co., Inc., 323 Ferry St., Newark, N. J.
Continental Motors Corp., Muskegon, Mich.
Continental Products Co., 1150 E. 222nd St., Euclid, O.
Continental Rubber Wks., 1905 Liberty Blvd., Erie, Pa.
Continental Steel Corp., 1108 S. Main St., Kokomo, Ind.
Continental Stove Corp., Front and Walnut Sts., Ironton, O.
Cook, Inc., A. D., Lawrenceburg, Ind.
Cook Electric Co., 2700 Southport Ave., Chicago, Ill.
Cooling Tower Co., Inc., The, Div. of The Fluor Corp., Ltd., 15 John St., New York, N. Y.
Coolmaster Corp., 530 S. Dearborn St., Chicago, Ill.
Cooper Co., Clark, 159 Jefferson St., Philadelphia, Pa.
Cooper Sanitary Co., 3316 Race St., Philadelphia, Pa.
Copeland Refrigeration Corp., Sidney, O.
Coppus Engineering Corp., 374 Park Ave., Worcester, Mass.
Corbman Bros., Inc., 1205 N. Fourth St., Philadelphia, Pa.
●Cork Import Corp., 330 W. 42nd St., New York, N. Y.
Cork Insulation Co., Inc., 155 E. 44th St., New York, N. Y.
Corley Co., 629 Grove St., Jersey City, N. J.
Cornell Wood Products Co., 230 N. Michigan Ave., Chicago, Ill.
Corning Glass Works, Corning, N. Y.

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Corozone Air Conditioning Corp., 1422 Euclid Ave., Cleveland, O.
Cramer Co., Inc., R. W., The, Centerbrook, Conn.
Crane Co., 836 S. Michigan Ave., Chicago, Ill.
Crane Packing Co., 1801 Belle Plaine Ave., Chicago, Ill.
Crawford Co., 3220 W. 31st St., Chicago, Ill.
Crescent Tool Co., 230 Harrison St., Jamestown, N. Y.
Crew-Equipment Co., Inc., 101 Park Ave., New York, N. Y.
Crise Elec. Mfg. Co., 14-16 E. Ohio Ave., Mt. Vernon, O.
Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.
Croll & Son, Jesse G., 2326-2606 Germantown Ave., Philadelphia, Pa.
Croll-Reynolds Engineering Co., Inc., 17 Johns St., New York, N. Y.
Cross Engineering Co., 160-178 Dundaff St., Carbondale, Pa.
Crown Cork & Seal Co., 4401 Eastern Ave., Baltimore, Md.
Crown Die & Tool Co., 267 N. California Ave., Chicago, Ill.
Crown Iron Works, 1229 N. E. Tyler, Minneapolis, Minn.
Crucible Steel Co. of America, 405 Lexington Ave., New York, N. Y.
Cryer Trap & Valve Co., Inc., 366 Madison Ave., New York, N. Y.
Cugley Incubator Co., Elkhart, Ind.
Cuno Engineering Corp., 80 S. Vine St., Meriden, Conn.
Curtis & Curtis Co., 450 Garden St., Bridgeport, Conn.
●Curtis Refrigerating Machine Co., 1950 Kienlen Ave., St. Louis, Mo.
Cutler-Hammer, Inc., N. 12th St. and W. St. Paul Ave., Milwaukee, Wis.

D

D & M Mfg. Co., 51 Lincoln Ave., Midland Park, N. J.
Dahlquist Mfg. Co., Inc., 40 W. 3rd St., Boston, Mass.
Dail Steel Products Co., 2000 Main St., Lansing, Mich.
Dallas Engineering Co., Inc., 1115 Hall, Dallas, Tex.
Dampney Co. of America, 1243 River St., Hyde Park, Boston, Mass.
Darcoid Co., Inc., 200 Varick St., New York, N. Y.
Darling Valve & Mfg. Co., 701 First St., Williamsport, Pa.
●Dart Mfg. Co., E. M., 134 Thurber Ave., Providence, R. I.
Davidson Co., M. T., 154 Nassau St., New York, N. Y.
Davidson Hy Duty Roof Fan Co., 213 California St., Newton, Mass.
Davies Air Filter Corp., 390 Fourth Ave., New York, N. Y.
Davis Engineering Corp., 1064 E. Grand St., Elizabeth, N. J.
Davis Regulator Co., 2546 S. Washtenaw Ave., Chicago, Ill.
Day Co., The, 2938 Pillsbury Ave., Minneapolis, Minn.
Dayton Air Compressor Co., Dayton, O.
Dayton-Dowd Co., 115-17 York St., Quincy, Ill.
Dayton Rubber Mfg. Co., 2345 W. Riverview Ave., Dayton, O.
Dean Bros. Co., 323 W. 10th St., Indianapolis, Ind.
Dean Hill Pump Co., Anderson, Ind.
Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, Ill.
Debevoise Co., The, 968 Grand Ave., Brooklyn, N. Y.
De Bothezat Ventilating Equipment Div., American Machine & Metals, Inc., East Moline, Ill.
Decatur Iron & Steel Co., Decatur, Ala.
Decatur Pump Co., 2750 Nelson Park Rd., Decatur, Ill.
Defender Automatic Regulator Co., 308 S. 8th St., St. Louis, Mo.
De Laval Steam Turbine Co., 300 Nottingham Way, Trenton, N. J.
De La Vergne Engine Co., Philadelphia, Pa.
Delco Appliance Co., Rochester, N. Y.
Delco Products Corp., 329 E. First St., Dayton, O.
Delta-Star Electric Co., 2400 Block, W. Fulton St., Chicago, Ill.
Delta Stoker Co., Foot of Commonwealth, North Chicago, Ill.
Deming Co., 14 Aetna St., Salem, O.
Desmond-Stephan Mfg. Co., Urbana, Ill.
Desolvo Mfg. Co., 33 Terminal Way, Pittsburgh, Pa.
Despatch Oven Co., 600 Ninth St., S. E., Minneapolis, Minn.
d'Este Co., Julian, 6 Spice St., Charlestown, Mass.
Detroit Air Meter Co., Box 1473, Detroit, Mich.
Detroit Brass & Malleable Works, 100 S. Campbell, Detroit, Mich.
Detroit Graphite Co., 550 12th St., Detroit, Mich.
●Detroit Lubricator Co., 5900 Trumbull Ave., Detroit, Mich.
Detroit Seamless Steel Tubes Co., c/o Grand River Station, Detroit, Mich.
Detroit Steel Products Co., 2250 E. Grand Blvd., Detroit, Mich.
Detroit Stoker Co., Sales and Engineering Offices, General Motors Bldg., Detroit, Mich.; Works at Monroe, Mich.
Detroit Stoker Co. of Canada, Ltd., Canada Bldg., Windsor, Ont.; Works at London, Ont.
DeVilbiss Co., The, 300 Phillips Ave., Toledo, O.
Devine Mfg. Co., Inc., J. P., 909 Shawnee Ave., Mt. Vernon, Ill.
●Devlin Mfg. Co., Inc., Thomas, Burlington, N. J.
Diamond Chain & Mfg. Co., 400 Kentucky Ave., Indianapolis, Ind.
Diamond Expansion Bolt Co., 500 North Ave., Garwood, N. J.
Diamond Mfg. Co., 253 W. Eighth St., Wyoming, Pa.
Diamond Metal Weather Strip Co., 650 N. Fourth St., Columbus, O.
Diamond Power Specialty Corp., 10340 Oakland, Detroit, Mich.
Dick Co., Inc., R. & J., 24-48 Sade St., Passaic, N. J.
Diehl Mfg. Co., Trumbull St., Elizabethport, N. J.
Dillon Steam Boiler Wks., Inc., D. M., Crocker St., Fitchburg, Mass.
Dissolene Corp., Hempstead, N. Y.
Dixon Crucible Co., Joseph, Wayne & Monmouth Sts., Jersey City, N. J.
Dockson Co., C. H., 3847 Wabash Ave., Detroit, Mich.
Dockstader, S. E., 1128 Munsey Bldg., Washington, D. C.
Dodge Mfg. Corp., 500 S. Union St., Mishawaka, Ind.
Doheny Co., John J., 326 Lake St., Belmont, Mass.
●Dole Valve Co., 1901-33 Carroll Ave., Chicago, Ill.
Domestic Engine & Pump Co., 50 Church St., New York, N. Y.
Dow Chemical Co., Midland, Mich.
Downingtown Iron Wks., Wallace Ave., Downingtown, Pa.
Dracco Corp., 4057 E. 116th St., Cleveland, O.
Dravo Corp., Dravo Bldg., Pittsburgh, Pa.
Drayer & Hanson, Inc., 738 E. Pico Blvd., Los Angeles, Cal.
Dreis & Krump Mfg. Co., 7404 Loomis Blvd., Chicago, Ill.
Dresser Mfg. Co., 490 Fisher Ave., Bradford, Pa.
●Dunham Co., C. A., 450 E. Ohio St., Chicago, Ill.
Dunn, Inc., Struthers, 1332 Cherry St., Philadelphia, Pa.
du Pont de Nemours & Co., Inc., E. I., The, R. & H. Chemicals Dept., Wilmington, Del.
du Pont de Nemours & Co., E. I., National Ammonia Div., Frankford, Philadelphia, Pa.
du Pont de Nemours & Co., Inc., E. I., Fabrics & Finishes Dept., Wilmington, Del.
Durabla Mfg. Co., 114 Liberty St., New York, N. Y.
Durakool, Inc., 1010 N. Main St., Elkhart, Ind.
Duraloy Co., Scottdale, Pa.
Duriron Co., Inc., 450 N. Findlay St., Dayton, O.
Duro Co., 537 Monument Ave., Dayton, O.
Dustlix Corp., 715 N. Van Buren St., Milwaukee, Wis.
Dwyer Mfg. Co., F. W., 565 W. Washington Blvd., Chicago, Ill.
Dyer Welder & Engineering Co., 2727 Walnut St., Kansas City, Mo.

E

Eagle-Picher Lead Co., Temple Bar Bldg., Cincinnati, O.
Eastern Foundry Co., Boyertown, Pa.
Eastern Foundry Co., Peerless Heater Div., Boyertown, Pa.
Easternoil, Inc., 133 Marginal Way, Portland, Me.
Eastman Kodak Co., Kodak Park, Rochester, N. Y.
Eckenroth Register Co., 447 Sutter St., San Francisco, Cal.
Eclipse Aviation, Div. of Bendix Aviation Corp., Bendix, N. J.
Eclipse Fuel Engineering Co., 707 S. Main St., Rockford, Ill.
Econocol Stoker Div. of Cotta Transmission Corp., 2340 11th St., Rockford, Ill.
Economy Electric Mfg. Co., 4606 W. 21st Pl., Chicago, Ill.
Economy Equipment Co., 223 N. Wolcott Ave., Chicago, Ill.
Economy Pumps, Inc., 2522 W. Congress St., Chicago, Ill.
Eddy Stoker Corp., 4717 W. North Ave., Chicago, Ill.
Eddy Valve Co., Waterford, N. Y.
Edge Moor Iron Wks., 30 Rockefeller Plaza, New York, N. Y.
Edison, Inc., Thomas A., Edison Electrical Controls Div., Lakeside Ave., West Orange, N. J.
Edward Valve & Mfg. Co., Inc., 1200 W. 145th St., East Chicago, Ind.
Edwards Mfg. Co., Inc., 337 Eggleston Ave., Cincinnati, O.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Elker Mfg. Co., Ogallala, Nebr.
Eisler Engineering Corp., 760 S. 13th St., Newark, N. J.
Electric Air Heater Co., Division of American Foundry Equipment Co., 555 Byrkit St., Mishawaka, Ind.
Electric Arc Cutting & Welding Co., 152 Jelliff Ave., Newark, N. J.
Electric Auto-Lite Co., Moto Meter Gauge & Equipment Div., Caledonia & Gillette Sts., La Crosse, Wis.
Electric Controller & Mfg. Co., 2700 E. 79th St., Cleveland, O.
Electric Machinery Mfg. Co., 1331 Tyler St., N. E., Minneapolis, Minn.
Electric Valve Mfg. Co., Inc., 68 Murray St., New York, N. Y.
Electrimatic Corp., 2100 Indiana Ave., Chicago, Ill.
Electroaire Corp., 1455-57 W. Congress St., Chicago, Ill.
Electrol, Inc., 934 Main Ave., Clifton, N. J.
Electrovent Fan & Mfg. Co., 812 W. Lake St., Chicago, Ill.
Elgin Softener Corp., Elgin, Ill.
Elgo Shutter & Mfg. Co., 634 W. Warren Ave., Detroit, Mich.
Elliott Co., Jeannette, Pa.
Ellis Drier Co., 2444 N. Crawford Ave., Chicago, Ill.
Ellison Draft Gage Co., 214 W. Kinzie St., Chicago, Ill.
Elsey Metal Specialties Co., 1535 Spruce St., Detroit, Mich.
Emerson Electric Mfg. Co., 1847 Washington Ave., St. Louis, Mo.
Empire Sheet & Tin Plate Co., N. Bowman St., Mansfield, O.
Endura Mfg. Corp., 45 N. 4th St., Quakerstown, Pa.
Engelhard, Inc., Charles, 90 Chestnut St., Newark, N. J.
Engineer Co., 17 Battery Pl., New York, N. Y.
Enterprise Oil Burner Co., 2949 18th St., San Francisco, Cal.
Erdle Perforating Co., 171 York St., Rochester, N. Y.
Erie Bolt & Nut Co., Erie, Pa.
Erie City Iron Wks., 1450 East Ave., Erie, Pa.
Erie Tool Wks., 11th & French Sts., Erie, Pa.
Everite Pump & Mfg. Co., Inc., Lancaster, Pa.
Everlasting Valve Co., 49 Fisk St., Jersey City, N. J.
Excelsior Leather Washer Co., 720-730 Chestnut St., Rockford, Ill.
Excelsior Steel Furnace Co., 118 So. Clinton St., Chicago, Ill.
Excelsior Tool & Machine Co., 31st & Ridge Ave., East St. Louis, Ill.

F

Fabling Co., W. D., 722 N. Broadway, Los Angeles, Cal.
Fafnir Bearing Co., 37 Booth St., New Britain, Conn.
●Fairbanks Co., 396 Lafayette St., New York, N. Y.

● Advertisement in this issue. See Index to Advertisers, page 208.

Fairbanks, Morse & Co., 600 Michigan Ave., Chicago, Ill.
Fairmont Aluminum Co., Fairmont, W. Va.
Falstrom Co., Main Ave. & D. L. & W. R. R., Passaic, N. J.
Farley Sleeve & Hanger Co., 3748 E. 71st St., Cleveland, O.
Farquhar Co., Ltd., A. B., Duke St., York, Pa.
Farrar & Trefts, 9 Grimes St., Buffalo, N. Y.
●Fedders Mfg. Co., Inc., 57 Tonawanda St., Buffalo, N. Y.
Federal Machine & Welder Co., 212 Dana St., Warren, O.
Federal-Mogul Corp., 11031 Shoemaker St., Detroit, Mich.
Fee & Mason Mfg. Co., Inc., 81 Beekman St., New York, N. Y.
Fee and Stemwedel, Inc., 4949 N. Pulaski Rd., Chicago, Ill.
Felt Products Mfg. Co., 1514 Carroll Ave., Chicago, Ill.
●Felters Co., Inc., 210 South St., Boston, Mass.
Ferguson & Lange Foundry Co., 1039 Willow St., Chicago, Ill.
Ferro-Nil Corp., 373 Fourth Ave., New York, N. Y.
Filtrine Mfg. Co., Inc., 53 Lexington Ave., Brooklyn, N. Y.
Fingles, Inc., W. A., Reistertown Rd. at Elgin Ave., Baltimore, Md.
Firemood Machine Wks., Converse, Ind.
Firestone Tire & Rubber Co., S. Main St., Akron, O.
Fir-Tex Insulating Board Co., St. Helens, Ore.
Fisher Governor Co., 205 S. First Ave., Marshalltown, Ia.
Fitzgibbons Boiler Co., Inc., 101 Park Ave., New York, N. Y.
Flagg & Co., Inc., Stanley G., 1421 Chestnut St., Philadelphia, Pa.
Flemm Lead Co., Inc., Bradley Ave. & School St., Long Island City, N. Y.
Flexitallic Gasket Co., 8th & Bailey Sts., Camden, N. J.
Flexo Supply Co., Inc., 4221 Olive St., St. Louis, Mo.
Flintkote Co., 50 W. 50th St., New York, N. Y.
Fluor Corp., Ltd., The, 909 E. 59th St., Los Angeles, Cal.
Flynn & Emrich Co., 801 Holliday St., Baltimore, Md.
Follansbee Bros. Co., 3rd & Liberty Aves., Pittsburgh, Pa.
Forman Machine & Electric Corp., 552 Seventh Ave., New York, N. Y.
Forslund Pump & Machinery Co., 1717-19 Main St., Kansas City, Mo.
Foster Engineering Co., 109 Monroe St., Newark, N. J.
Foster Pump Wks., Inc., 46-A Washington St., Brooklyn, N. Y.
Foster Wheeler Corp., 165 Broadway, New York, N. Y.
Fowler & Wolfe Radiator Co., Oak & Carson Sts., Norristown, Pa.
Foxboro Co., 106 Neponset Ave., Foxboro, Mass.
France Packing Co., 6512 Tacony St., Tacony, Philadelphia, Pa.
Frank Heaters, Inc., 150 Railroad Ave., Paterson, N. J.
Frederick Iron and Steel Co., E. 7th St., Frederick, Md.
Fresh-'nd Air Co., 2626 W. Washington Blvd., Chicago, Ill.
Fretz-Moon Tube Co., Inc., Butler, Pa.
●Frick Co., Waynesboro, Pa.
Friez & Sons, Julien P., 4 N. Central Ave., Baltimore, Md.
Frigidaire Commercial & Air Conditioning Div., General Motors Sales Corp., Dayton, O.
Frost Mfg. Co., S. Henderson St., Galesburg, Ill.
Fuel Savers, Inc., 15th & Herr Sts., Harrisburg, Pa.
Fulflo Specialties Co., Inc., The, Blanchester, O.
Fuller Co., 124 Bridge St., Catasauqua, Pa.
●Fulton Syiphon Co., Knoxville, Tenn.
Furblo Co., Hermansville, Mich.

G

G. M. Mfg. Co., P. O. Box 151, Madison Square Sta., New York, N. Y.
●G & O Mfg. Co., 138 Winchester Ave., New Haven, Conn.
G. D. S. Machinery & Supply Co., Inc., 101 Walker St., New York, N. Y.
Gale Products, Galesburg, Ill.
Gallaher Boiler Co., 3615 LaClede Ave., St. Louis, Mo.
Garden City Fan Co., 332 S. Michigan Ave., Chicago, Ill.
Gardiner Metal Co., 2514 W. 48th Pl., Chicago, Ill.
Gardner-Denver Co., Quincy, Ill.
Garlock Packing Co., 50 Main St., Palmyra, N. Y.
Gas City Glass Co., Gas City, Ind.
Gasweld Equipment Co., 625 W. Jackson Blvd., Chicago, Ill.
Gates Rubber Co., 999 S. Broadway, Denver, Colo.
Gatke Corp., 228 N. La Salle St., Chicago, Ill.
Gehl Bros. Mfg. Co., West Bend, Wis.
Gehri Co., 1117 Tacoma Ave., Tacoma, Wash.
General Air Conditioning Corp., 4411 Appleton St., Cincinnati, O.
General Blower Co., Inc., 2402 Market St., Philadelphia, Pa.
General Ceramics Co., 30 Rockefeller Plaza, New York, N. Y.
General Controls Co., 700 W. Ivy St., Glendale, Cal.
●General Electric Co., Air Conditioning and Commercial Refrigeration Dept., 5 Lawrence St., Bloomfield, N. J.
General Electric Co., Lamp Dept., Nela Park, Cleveland, O.
General Electric Co., 1 River Rd., Schenectady, N. Y.
General Equipment Co., 315 S. Wichita, Wichita, Kan.
General Fittings Co., 123 Georgia Ave., Providence, R. I.
General Furnaces Corp., 17 State St., New York, N. Y.
General Gas Light Co., 212 N. Park, Kalamazoo, Mich.
General Insulating & Mfg. Co., 705 Olive St., St. Louis, Mo.
General Insulating Products Co., 8821 15th Ave., Brooklyn, N. Y.
General Machinery Co., 3500 Riverside Ave., Spokane, Wash.
General Motors Corp., Detroit, Mich.
General Plate Co., 34 Forrest St., Attleboro, Mass.
General Refrigeration Corp., Shirland Ave., Beloit, Wis.
General Regulator Corp., 2608 Arthington St., Chicago, Ill.
Gerstein & Cooper Co., 1 W. Third St., South Boston, Mass.
Giant Grip Mfg. Co., 30 Osceola St., Oshkosh, Wis.
Giant Mfg. Co., South Ave., Council Bluffs, Ia.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Gillian Mfg. Co., 650 E. Troy Ave., Ferndale, Mich.
Gilmer Company, L. H., 7230 Keystone St., Tacony, Philadelphia, Pa.
Gleason-Avery, Inc., 27 Clark St., Auburn, N. Y.
Globe Machine & Stamping Co., 1220 W. 76th St., Cleveland, O.
Globe Steel Tubes Co., 3839 W. Burnham St., Milwaukee, Wis.
Glore Sales Corp., Evins F., 1939 Grand Central Terminal Bldg., New York, N. Y.
Goese Mfg. Co., 2548 N. 18th St., Milwaukee, Wis.
Goethel Co., Alfred C., 2337 N. 31st St., Milwaukee, Wis.
Goethel Sheet Metal Wks., Alfred, 1910 N. Killian Pl., Milwaukee, Wis.
Goetze Gasket & Packing Co., Inc., 60 Allen Ave., New Brunswick, N. J.
Golden-Anderson Valve Specialty Co., Fulton Bldg., Pittsburgh, Pa.
Goldens' Foundry & Machine Co., Columbus, Ga.
Goodrich Co., B. F., 548 S. Main St., Akron, O.
Goodyear Tire & Rubber Co., E. Market St., Akron, O.
Gorton Heating Corp., Cranford, N. J.
Goulds Pumps, Inc., Fall St., Seneca Falls, N. Y.
Governair Corp., 605 W. Main St., Oklahoma City, Okla.
Grabler Mfg. Co., 6565 Broadway, Cleveland, O.
Grand Rapids Blow Pipe & Dust Arrester Co., 525-28 Monroe Ave., Grand Rapids, Mich.
Grand Rapids Die & Tool Co., 113-117 Michigan St., Grand Rapids, Mich.
Granite City Steel Co., 20th & Madison Ave., Granite City, Ill.
Graton & Knight Mfg. Co., 356 Franklin St., Worcester, Mass.
Graver Tank & Mfg. Co., Inc., 4809 Todd Ave., East Chicago, Ind.
Greene, Tweed & Co., 109 Duane St., New York, N. Y.
Greenfield Tap & Die Corp., Sanderson St., Greenfield, Mass.
Grief, Edward C., 64 West End Ave., Bogota, N. J.
●Grinnell Co., Inc., 260 W. Exchange, Providence, R. I.
Griscom-Russell Co., The, 285 Madison Ave., New York, N. Y.
Grobet File Corp. of America, 3 Park Pl., New York, N. Y.
Guardian Electric Mfg. Co., 1621 W. Walnut St., Chicago, Ill.
Grove Regulator Co., 1729 Poplar St., Oakland, Cal.
Guardian Utilities Co., 215 E. Michigan St., Michigan City, Ind.
Guild & Garrison, Inc., 43 Keap St., Brooklyn, N. Y.
Guth Co., Edwin F., 2615 Washington Blvd., St. Louis, Mo.
Gylstrom Co., O., 108 W. Wells St., Milwaukee, Wis.

H

H-B Instrument Co., 2518 N. Broad St., Philadelphia, Pa.
H. & B. Sales Co., Ltd., 2875 Cherry Ave., Long Beach, Cal.
Haering Co., Inc., D. W., 2308 S. Winchester Ave., Chicago, Ill.
Hagan Corp., 600 Bowman Bldg., Pittsburgh, Pa.
Hague & Co., Inc., Alfred, 227 Thirty-fourth St., Brooklyn, N. Y.
Haines & Co., William S., 12th & Buttonwood Sts., Philadelphia, Pa.
●Hall Mfg. Co., Cedar Rapids, Ia.
Hamburg Boiler Wks., Inc., Grand St., Hamburg, Pa.
Hamilton Rubber Mfg. Co., Mead St., Trenton, N. J.
Hammett Mfg. Co., 209 W. 19th Ter., Kansas City, Mo.
Hammond Brass Wks., Summer Blvd., Hammond, Mich.
Hampton Electric Tool Co., 700 Walnut St., Edgewood, Pittsburgh, Pa.
Handley Brown Heater Co., Jackson, Mich.
Handy & Harman, 82 Fulton St., New York, N. Y.
Hardinge Mfg. & Oil Burner Co., 1770 Berteau St., Chicago, Ill.
Hardy Mfg. Co., Inc., 126 Davis Ave., Dayton, O.
Harnischfeger Corp., 4400 W. National Ave., Milwaukee, Wis.
Harrington & King Perforating Co., 5655 Fillmore St., Chicago, Ill.
Harris, A. R., 4548 Hohman Ave., Hammond, Ind.
Harris & Co., Arthur, 210 N. Aberdeen St., Chicago, Ill.
Harris Calorific Co., The, 5501 Cass Ave., N. W., Cleveland, O.
Harrisburg Foundry & Machine Co., Inc., 7th & Curtin St., Harrisburg, Pa.
Harrisburg Steel Corp., 10th & Herr Sts., Harrisburg, Pa.
Harrison Radiator Div., Lockport, N. Y.
Hart & Cooley Mfg. Co., 61 Kinzie St., Chicago, Ill.; Factory, Holland, Mich.
Hart & Crouse Corp., 301 Turner St., Utica, N. Y.
Hart Mfg. Co., Hamilton St., Hartford, Conn.
Hartmann Co., Chas., 985 Dean St., Brooklyn, N. Y.
Hartzell Propeller Fan Co., P. O. Box 909, Roosevelt Ave., Piqua, O.
Harvey-Whipple, Inc., Springfield, Mass.
Hasco Valve & Machine Co., 1819 W. St. Paul Ave., Milwaukee, Wis.
Haskell Mfg. Co., Wm. H., 20 Commerce St., Pawtucket, R. I.
Hastings Air Conditioning Co., Box 481, 615 W. South St., Hastings, Neb.
Hays Corp., E. 8th St., Michigan City, Ind.
Hays Mfg. Co., 801 W. 12th St., Erie, Pa.
Healy Ruff Co., 765 Hampden Ave., St. Paul, Minn.
Heartley Machine & Tool Co., 900-8 Summit Ave., Toledo, O.
Heating Assurance, Inc., 124 E. Augusta St., Spokane, Wash.
Hegeler Zinc Co., P. O. Box 599, Danville, Ill.
Hendley & Whittemore, 6 Blackhawk Blvd., Beloit, Wis.
Hendrick Mfg. Co., 37 Dundaff St., Carbondale, Pa.
●Henry Furnace & Foundry Co., 3480 E. 49th St., Cleveland, O.
●Henry Valve Co., 1019 N. Spaulding Ave., Chicago, Ill.

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Henry & Wright Mfg. Co., 760 Windsor St., Hartford, Conn.
Herbert Boiler Co., Root & La Salle Sts., Chicago, Ill.
Her-Born Engineering & Mfg. Co., 212 Columbus Ave., Sandusky, O.
Herbusch Corp., The, 706 Chestnut St., 210 Title Guaranty Bldg., St. Louis, Mo.
Hercules Chemical Co., Inc., 332 Canal St., New York, N. Y.
Hercules Float Wks., 200 Franklin St., Springfield, Mass.
Hershey Machine & Foundry Co., Motorstoker Div., Manheim, Pa.
Herske & Timmis, Inc., 33 W. 60th St., New York, N. Y.
●Hess Warming & Ventilating Co., 1211 S. Western Ave., Chicago, Ill.
Hetzel Roofing Products Co., 67 Main St., Newark, N. J.
Higgin Products, Inc., Newport, Ky.
Hill Diesel Engine Co., Lansing, Mich.
Hill, E. Vernon, 6826 W. Highland Ave., Chicago, Ill.
Hilo Varnish Corp., 42-60 Stewart Ave., Brooklyn, N. Y.
Hinde & Dauch Paper Co., Sandusky, O.
Hirschman Co., W. F., 1245 McKinley Parkway, Buffalo, N. Y.
Hobart Bros., Hobart Sq., Troy, O.
Hodge Boiler Wks., Summer St., East Boston, Mass.
Hodgman Mfg. Co., 135 Washington St., Taunton, Mass.
Hoffman Combustion Engineering Co., 710 Marquette Bldg., Detroit, Mich.
Hoffman Specialty Co., Inc., Waterbury Natl. Bank Bldg., Waterbury, Conn.
Holcomb & Hoke Mfg. Co., 1545 Van Buren, Indianapolis, Ind.
Hollands Mfg. Co., Erie, Pa.
Hollup Corp., 3357 W. 47th Pl., Chicago, Ill.
Holsclaw Bros., Inc., Evansville, Ind.
Holtum Mfg. Co., Freeport, Ill.
Holtzer-Cabot Electric Co., 125 Amory St., Boston, Mass.
Homestead Valve Mfg. Co., P. O. Box 348, Coraopolis, Pa.
Hoppes Mfg. Co., 850 N. Belmont Ave., Springfield, O.
Horn Co., A. C., 43-36 Tenth St., Long Island City, N. Y.
Horton Mfg. Co., 3016 University Ave., S. E., Minneapolis, Minn.
Hossfeld Mfg. Co., 460 W. Third St., Winona, Minn.
Hotstream Heater Co., 8007 Grand Ave., Cleveland, O.
Houghton & Co., E. F., 240 W. Somerset St., Philadelphia, Pa.
Hound Packing Co., 4757 E. Ravenswood Ave., Chicago, Ill.
Howard Iron Wks. & Alberger Heater Co., 287 Chicago St., Buffalo, N. Y.
Howe Ice Machine Co., 2825 Montrose Ave., Chicago, Ill.
●Howell Electric Motors Co., Howell, Mich.
Howell Mfg. Co., 1341 Montgall, Kansas City, Mo.
Howes Co., S. M., 511 Medford St., Charlestown District, Boston, Mass.
Hubbell Corp., 1315 W. Carroll Ave., Chicago, Ill.
Hudson Equipment Corp., 324 Third Ave., N., Minneapolis, Minn.
Hugo Mfg. Co., 49th Ave., W., & Superior St., West Duluth, Minn.
Hull Mfg. Co., Pennsylvania & Prospect Ave., Hagerstown, Md.
Hunt & Son, C. B., Salem, O.
●Hussey & Co., C. G., 2850 Second Ave., Pittsburgh, Pa.
Huyette Co., Inc., Paul B., 401 N. Broad St., Philadelphia, Pa.
Hyatt Bearings Div., General Motors Sales Corp., Harrison, N. J.
Hynes Electric Heating Co., 210 Cherry St., Philadelphia, Pa.

I

Ice Cooling Appliance Corp., Morrison, Ill.
Ideal Commutator Dresser Co., 1096 Park Ave., Sycamore, Ill.
Ideal Electric & Mfg. Co., E. First & Oak Sts., Mansfield, O.
Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago, Ill.
●Illinois Engineering Co., 2035 S. Racine Ave., Chicago, Ill.
Illinois Iron & Bolt Co., 918 S. Michigan Ave., Chicago, Ill.
Illinois Malleable Iron Co., 1801 Diversey Ave., Chicago, Ill.
●Illinois Testing Laboratories, 419 N. La Salle St., Chicago, Ill.
Illinois Zinc Co., 47th St. at Sacramento Ave., Chicago, Ill.
Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago, Ill.
Imperial Electric Co., 64 Ira Ave., Akron, O.
Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill.
●Independent Register Co., 3747 E. 93rd St., Cleveland, O.
Indian Trailer Corp., Koolroom Div., 2338 Indiana Ave., Chicago, Ill.
Industrial Apparatus Co., 720 N. Wabash Ave., Chicago, Ill.
Industrial Engineering Corp., Evansville, Ind.
●Industrial Mfg. & Engineering Co., 3845 N. Ravenswood Ave., Chicago, Ill.
Industrial Research, Lansdowne, Pa.
Industrial Service Laboratories, 915 W. Oklahoma Ave., Milwaukee, Wis.
Industrial Sheet Metal Wks., Inc., 628 E. Forest Ave., Detroit, Mich.
Ingersoll-Rand, 11 Broadway, New York, N. Y.
Ingersoll Steel & Disc Co., 310 S. Michigan Ave., Chicago, Ill.
Inland Mfg. Co., 1120 N. Cicero Ave., Chicago, Ill.
Inland Steel Co., 38 S. Dearborn St., Chicago, Ill.
Inner-Tite Clamp Corp., 18 W. Jersey St., Elizabeth, N. J.
Insto-Gas Corp., 1900 E. Jefferson, Detroit, Mich.
Insulite Co., 1100 Builders Exchange Bldg., Minneapolis, Minn.
Insul-Wool Insulation Corp., Wichita, Kan.
Inter-Coastal Paint Corp., 15th St., and Southern R. R., East St. Louis, Ill.
International Boiler Works, East Stroudsburg, Pa.
●International Correspondence Schools, Scranton, Pa.
International Engineering, Inc., 1145 Bolander Ave., Dayton, O.
International Engineering Wks., Inc., Box 71, Framingham,
●International Exposition Co., Grand Central Palace, New York, N. Y.
International Heater Co., 101 Park Ave., Utica, N. Y.
International Moistening Co., 489 S. Main St., Providence, R. I.
International Nickel Co., 67 Wall St., New York, N. Y.
International Nutyp Tool Corp., 68 W. First St., Oswego, N. Y.
International Steel Co., 1545 Edgar St., Evansville, Ind.
International Vermiculite Co., 11th & Stanford Ave., Springfield, Ill.
Iona Ventilator Co., Inc., 2821-29 W. Dauphin St., Philadelphia, Pa.
Iowa Paint Mfg. Co., 118-20 Eighth St., Des Moines, Ia.
Iron Fireman Mfg. Co., 3170 W. 106 St., Cleveland, O.
Iwan Brothers, 1503 Prairie Ave., South Bend, Ind.

J

Jackson & Church Co., 321 N. Hamilton Ave., Saginaw, Mich.
Jacobs Co., B. & J., 1729 John St., Cincinnati, O.
Jaden Mfg. Co., Inc., F., 1601 Second St., Hastings, Nebr.
Jamar Co., Walker, 367 S. First Ave., E. Duluth, Minn.
Janette Mfg. Co., 556 W. Monroe St., Chicago, Ill.
Jarecki Mfg. Co., 1345 W. 12th St., Erie, Pa.
Jefferson Electric Co., 25th & Madison St., Bellwood, Ill.
Jefferson Union Co., Sales Office, 601 W. 26th St., New York, N. Y.; Factory, Lexington, Mass.
Jeffrey Mfg. Co., 956 N. Fourth St., Columbus, O.
Jenkins Bros., 80 White St., New York, N. Y.
Jenkins Mfg. Co., 2 W. 45th St., New York, N. Y.
Jennison Co., 17 Putnam St., Fitchburg, Mass.
Jessop Steel Co., Washington, Pa.
●Jewel Mfg. Co., 1874 Highland Parkway, St. Paul, Minn.
Johns-Manville, 22 E. 40th St., New York, N. Y.
Johnson Bronze Co., 460 S. Mill St., New Castle, Pa.
Johnson Co., S. T., 940 Arlington St., Oakland, Cal.; 401 N. Broad St., Philadelphia, Pa.
Johnson Corp., 830 Wood St., Three Rivers, Mich.
Johnson Fan & Blower Corp., 1320 W. Lake St., Chicago, Ill.
Johnson Gas Appliance Co., 520 "E" Ave., N. W., Cedar Rapids, Ia.
Johnson Mfg. Co., 10th & Sycamore, Waterloo, Ia.
●Johnson Service Co., 507 E. Michigan St., Milwaukee, Wis.
Johnson Tool Co., 65-67 Massasoit Ave., East Providence, R. I.
Johnston Bros., Inc., Ferrysburg, Mich.
Johnston Co., William W., 115 Bayard St., Dayton, O.
Johnston & Jennings Co., 877 Addison Rd., Cleveland, O.
Johnston Tin Foil & Metal Co., 6100 S. Broadway, St. Louis, Mo.
Jones Foundry & Machine Co., W. A., 4401 Roosevelt Rd., Chicago, Ill.
Jones & Laughlin Steel Corp., Third & Ross St., Pittsburgh, Pa.
Jordan & Co., Paul R., 631 S. Delaware St., Indianapolis, Ind.
Justus Steam Trap Co., Napanoch, N. Y.

K

Kainer & Co., 761 W. Lexington, Chicago, Ill.
Kaiser Co., H. S., 3336 Franklin Blvd., Chicago, Ill.
Kauffman Air Conditioning Corp., 4336 W. Pine Blvd., St. Louis, Mo.
Kaye & MacDonald, Inc., 92 Franklin Ave., West Orange, N. J.
Keasbey & Mattison Co., Butler Ave., Ambler, Pa.
Keasbey Co., Robert A., 139-149 W. 19th St., New York, N. Y.
Keckley Co., O. C., 400 W. Madison St., Chicago, Ill.
Keeler Co., E., 238 West St., Williamsport, Pa.
Keeney Mfg. Co., Main St., Newington, Conn.
Kehm Corp., The, 51 E. Grand Ave., Chicago, Ill.
Keldur Corp., 420 Lexington Ave., New York, N. Y.
Kellogg Co., M. W., The, 225 Broadway, New York, N. Y.
Kelly-Koet, Covington, Ky.
Kelvin-White Co., 90 State St., Boston, Mass.
Kelvinator Div., Nash-Kelvinator Corp., 14250 Plymouth Rd., Detroit, Mich.
Kennard, Inc., Sam, 3333-35 Market St., St. Louis, Mo.
Kennedy Valve Mfg. Co., The, Elmira, N. Y.
Kerentoff, G. L., 2803 Jefferson Ave., Cincinnati, O.
Kernchen Co., 103 E. Wacker Drive, Chicago, Ill.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh, Pa.
Kester Solder Co., 4201 Wrightwood Ave., Chicago, Ill.
●Kewanee Boiler Corp., Kewanee, Ill.
Key Co., 2700 McCasland, East St. Louis, Ill.
Kidder Mfg. Co., Inc., J. F., 426 Colchester Ave., Burlington, Vt.
Kieley & Mueller, Inc., 34 W. 13th St., New York, N. Y.
Kimball-Krogh Pump Div., Food Machinery Corp., 301 West Ave. 26, Los Angeles, Cal.
Kimberly-Clark Corp., Neenah, Wis.
Kinetic Chemicals, Inc., 10th & Market St., Wilmington, Del.
King Engineering Corp., 1940 Willard Ave., Ann Arbor, Mich.
King Union Co., Inc., Hillsgrove, R. I.

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King Ventilating Co., Box 178, Owatonna, Minn.
Kingsford Foundry & Machine Wks., 264 W. Second St., Oswego, N. Y.
Kinney Mfg. Co., 3529 Washington St., Boston, Mass.
Kirk & Blum Mfg. Co., 2838-52 Spring Grove Ave., Cincinnati, O.
Kisco Co., Inc., 39th and Chouteau Ave., St. Louis, Mo.
Kisco Boiler & Engineering Co., 3732 Chouteau Ave., St. Louis, Mo.
Kleenaire Corp., 409 Jefferson St., Stevens Point, Wis.
Klingerit, Inc., 16-22 Hudson St., New York, N. Y.
Klipfel Mfg. Co., 2651 W. Harrison St., Chicago, Ill.
Knickerbocker Co., Jackson, Mich.
Knight, Maurice A., Kelly Ave., Akron, O.
Knowles Mushroom Ventilator Co., 11 Label St., Montclair, N. J.
Kol-Master Corp., Oregon, Ill.
Kopperman & Sons, Joseph, 316 New St., Philadelphia, Pa.
Korfund Co., 48-15 32nd Pl., Long Island City, N. Y.
Koven & Bro., L. O., 154 Ogden Ave., Jersey City, N. J.
Kraissl Co., Inc., The, Terhune and Williams Aves., Hackensack N. J.
Kramer Trenton Co., 626 Brunswick Ave., Trenton, N. J.
Krehbiel, J. H., 425 N. Crawford Ave., Chicago, Ill.
Kuhlman Electric Co., Detroit Electric Furnace Div., Bay City, Mich.
Kuhns Bros. Co., 1800 McCall St., Dayton, O.

L

La Bour Pump Co., Inc., 1301 Sterling Ave., Elkhart, Ind.
Laclede Steel Co., Arcade Bldg., Rm. 1317, St. Louis, Mo.
Laclede Stoker Co., 4438 Hunt Ave., St. Louis, Mo.
La Crosse Steel Roofing & Corrugating Co., 300 S. Third St., La Crosse, Wis.
La Crosse Tractor Co., La Crosse, Wis.
Lammert & Mann Co., 281 N. Wood St., Chicago, Ill.
Lamneck Products, Inc., 416-36 Dublin Ave., Columbus, O.
Lamson & Sessions Co., 1971 W. 85th St., Cleveland, O.
Landis Machine Co., 5th & Church Sts., Waynesboro, Pa.
Larkin Coils, Inc., 519 Fair St., S. E., Atlanta, Ga.
Larkin Packer Co., 6200 Maple Ave., St. Louis, Mo.
Lastik Products Co., Inc., 603 American Bank Bldg., Pittsburgh, Pa.
Lau Blower Co., 2001 Home Ave., Dayton, O.
Lawler Automatic Controls, Inc., 453 N. MacQuesten Pkwy., Mount Vernon, N. Y.
Lawrence Pump & Engine Co., P. O. Box 70, Lawrence, Mass.
Lawson Co., F. H., Evans & Whately Sts., Cincinnati, O.
Layne & Bowler, Inc., Memphis, Tenn.
Lead Lined Iron Pipe Co., 1 Broadway, Wakefield, Mass.
Leavitt Machine Co., East River St., Orange, Mass.
Lecourtenay Co., 5 Maine St., Newark, N. J.
Lee Engineering Co., 810 Union National Bank Bldg., Youngstown, O.
Lee & Son Co., K. O., Aberdeen, S. D.
Lee & Son Co., Thomas, 128-132 W. Second St., Cincinnati, O.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia, Pa.
Leffel & Co., James, 426 East St., Springfield, O.
Lehigh Fan & Blower Co., Front & Linden Sts., Allentown, Pa.
Leland Electric Co., 1501 Webster St., Dayton, O.
Lennox Furnace Co., Marshalltown, Ia., and Syracuse, N. Y.
Leonard Valve Co., Elmwood Station, Providence, R. I.
Leslie Co., Valley Brook & Grant Aves., Lyndhurst, N. J.
Lewis & Co., Inc., Chas. S., 2207 Pine St., St. Louis, Mo.
Levow, David, 308 W. 20th St., New York, N. Y.
Libbey-Owens-Ford Glass Co., Box 919, Toledo, O.
Lilie-Hoffman Cooling Towers, Inc., 4239 Duncan Ave., St. Louis Mo.
Limbert & Co., Geo. B., 570 Fulton St., Chicago, Ill.
Lincoln Electric Co., 12818 Coit Rd., Cleveland, O.
Linde Air Products Co., The, Unit of Union Carbide & Carbon Corp., 30 E. 42nd St., New York, N. Y.
Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.
Lion Mfg. Corp., 2701-11 Belmont Ave., Chicago, Ill.
Liquid Carbonic Corp., 3100 S. Kedzie Ave., Chicago, Ill.
Liquidometer Corp., 37-15 Skillman Ave., Long Island City, N. Y.
Lissberger & Son, Inc., Marks, 23-01 Borden Ave., Long Island City, N. Y.
Little Mfg. Co., M. S., 151 New Park Ave., Hartford, Conn.
Littleford Bros., 421 E. Pearl St., Cincinnati, O.
Locke Regulator Co., 76 North St., Salem, Mass.
Lockformer Co., The, 4630 W. Flournoy St., Chicago, Ill.
Lockport Fittings Co., Inc., Lockport, N. Y.
Logan Electric Specialty Mfg. Co., 412 S. Market St., Chicago, Ill.
Logan Engineering Co., Lawrence & Lamon Ave., Chicago, Ill.
Logansport Radiator Equipment Co., Logansport, Ind.
Lohman, Inc., Wm. J., 62 Ninth Ave., New York, N. Y.
Lonergan Co., J. E., 211 Race St., Philadelphia, Pa.
Long Mfg. Co., Div. Borg-Warner Corp., 12501 Dequendle St., Detroit, Mich.
Lookout Boiler & Mfg. Co., Compress St. & Mfrs. Rd., Chattanooga, Tenn.
Lord Mfg. Co., 1633 W. 12th St., Erie, Pa.
Lovejoy Flexible Coupling Co., 5024 W. Lake St., Chicago, Ill.
Lowell Air Conditioning Corp., Otis Bldg., Philadelphia, Pa.
Lowell Wrench Co., 54 Commercial St., Worcester, Mass.
Loyal Knight Stokers, Inc., 24th & W. Main St., Belleville, Ill.
Ludlow Valve Mfg. Co., Foot of Adams St., Troy, N. Y.
Lukens Steel Co., 308 S. First Ave., Coatesville, Pa.
Lumsden & Van Stone Co., 426 First St., South Boston, Mass.
Lunkenheimer Co., Waverly & Beekman Sts., Cincinnati, O.
Luzerne Rubber Co., Muirhead Ave., Trenton, N. J.
Lycoming Mfg. Co., Williamsport, Pa.
Lynchburg Foundry Co., Peoples Bank Bldg., Lynchburg, Va.
Lyon, Conklin & Co., Inc., McComas & Race Sts., Baltimore, Md.
Lytton Mfg. Corp., 102 First Ave., Franklin, Va.

M

Maas & Waldstein Co., 438 Riverside Ave., Newark, N. J.
Macksons Co., 125 Cedar St., New York, N. Y.
Macrae Inc., 554 Vanderbilt Ave., Brooklyn, N. Y.
Magirl Foundry & Furnace Wks., P. H., 413 E. Oakland Ave., Bloomington, Ill.
● Magnet Switch Co., 356 W. Huron St., Chicago, Ill.
● Maid-O-Mist, Inc., 180 N. Wacker Dr., Chicago, Ill.
Maintenance Engineering Corp., 3611 Clinton Dr., Houston, Texas.
Majestic Co., 733 Erie St., Huntington, Ind.
Mall Tool Co., 7740 S. Chicago Ave., Chicago, Ill.
● Malleable Iron Fittings Co., Branford, Conn.
Mallory Sales Co., 13904 Lincoln Ave., Dolton, Ill.
Manhattan Perforated Metal Co., Inc., 43-17 37th St., Long Island City, N. Y.
Manhattan Rubber Mfg., Div. of Raybestos-Manhattan, Inc., 61 Willett St., Passaic, N. J.
Manitowoc Boiler Wks., 16th & The River, Manitowoc, Wis.
Manley Products Corp., State & Hay Sts., York, Pa.
Manning, Maxwell & Moore, Inc., American Schaeffer & Budenberg Instrument Div., 11 Elias St., Bridgeport, Conn.
Manning, Maxwell & Moore, Inc., Ashcroft American Gauge Div., Bridgeport, Conn.
Manning, Maxwell & Moore Inc., Consolidated Safety Valve Div., Bridgeport, Conn.
Manning, Maxwell & Moore, Inc., Hancock Valve Div., 11 Elias St., Bridgeport, Conn.
Manufacturers Fin Coil Co., 2505-7 S. Pulaski Rd., Chicago, Ill.
Manufacturers Machine Co., Railroad Ave., North Andover, Mass.
Maple Valley Mfg. Co., First St., Mapleton, Ia.
Maplewood Machinery Co., Inc., 2634 Fullerton Ave., Chicago, Ill.
Marathon Electric Mfg. Corp., Plumer's Island, P. O. 298 Wausau, Wis.
Marble-Card Electric Co., Gladstone, Mich.
Marblehead Lime Co., 160 N. LaSalle St., Chicago, Ill.
Marion Machine, Foundry & Supply Co., P. O. Box 685, 3rd and Big Four Ry., Marion, Ind.
● Marley Co., 3001 Fairfax Rd., Kansas City, Kans.
Marlin-Rockwell, Jamestown, N. Y.
● Marlo Coil Co., 6135 Manchester Ave., St. Louis, Mo.
Marquette Mfg. Co., 401 Johnson St., Minneapolis, Minn.
Marsh Corp., Jas. P., 2073 Southport Ave., Chicago, Ill.
Marsh Tritrol Co., 600 S. Michigan Ave., Chicago, Ill.
Marsh Valve Co., 4th St. & Brigham Rd., Dunkirk, N. Y.
Marshalltown Mfg. Co., 901 E. Nevada, Marshalltown, Ia.
Martin, J. O. & C. U., 637 Minna St., San Francisco, Cal.
Martin Metal Mfg. Co., 900 E. Second St., Wichita, Kan.
Martin & Sons, H. P., 801 W. 12th St., Owensboro, Ky.
Martocello & Co., Jos. A., 229 N. 13th St., Philadelphia, Pa.
Masonite Corp., 111 W. Washington St., Chicago, Ill.
Masonite Corp., Cellufoam Products Div., 6565 S. Lavergne Ave., Chicago, Ill.
Mason-Neilan Regulator Co., 1190 Adams St., Boston, Mass.
Master Electric Co., 100 Davis Ave., Dayton, O.
Master Welders, 2524 Holmes St., Kansas City, Mo.
Matthiessen & Hegeler Zinc Co., 9th & Sterling Sts., La Salle, Ill.
Mauck Seamless Copper Tank Co., Victor, 309 E. Main, Norristown, Pa.
Maurath, Inc., 7309 Union Ave., Cleveland, O.
Maxim Silencer Co., 410 Asylum St., Hartford, Conn.
Maxweld Corp., 140 13th St., Brooklyn, N. Y.
Mayflower Air-Conditioners, Inc., E. 7th St. at Duluth, St. Paul, Minn.
Mayson Mfg. Co., Inc., 4332 Horatio St., Detroit, Mich.
McAlear Mfg. Co., 1901-1909 S. Western Ave., Chicago, Ill.
McAuley Trap Co., 405 Penn Ave., Pittsburgh, Pa.
McCann Furnace Co., 1526 W. 25th St., Cleveland, O.
McClave-Brooks Co., Poplar & Parks Sts., Scranton, Pa.
● McCord Radiator & Mfg. Co., 2587 E. Grand Blvd., Detroit, Mich.
McCorkle Co., D. H., 6th & Bancroft Way, Berkeley, Cal.
McDonnell & Miller, 400 N. Michigan Ave., Chicago, Ill.
McGowan Co., John H., 54-58 Central Ave., Cincinnati, O.
McKay Co., McKay Bldg., 1005 Liberty Ave., Pittsburgh, Pa.
McLeod & Henry Co., Troy, N. Y.
McPherson Furnace & Supply Co., 1805 N. E. Second Ave., Portland, Ore.
● McQuay, Inc., 1600 Broadway, N. E., Minneapolis, Minn.
● McQuay-Norris Mfg. Co., Southwest Ave. at Marconi, St. Louis, Mo.

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McWane Cast Iron Pipe Co., 1201 Vanderbilt Rd., Birmingham, Ala.
Mears-Kane-Ofeldt, Inc., 1903-1915 E. Hagert St., Philadelphia, Pa.
Medart Co., 3500 DeKalb, St. Louis, Mo.
Meier Electric & Machine Co., 3525 E. Washington St., Indianapolis, Ind.
Mellish & Murray Co., 1715 Carroll Ave., Chicago, Ill.
Merchant & Evans Co., 2035 Washington Ave., Philadelphia, Pa.
Mercoid Corp., The, 4201 Belmont Ave., Chicago, Ill.
Merco-Nordstrom Valve Co., 400 N. Lexington Ave., Pittsburgh, Pa.
●Meriam Co., The, 1955 W. 112th St., Cleveland, O.
Merrell Mfg. Co., 644 Curtis St., Toledo, O.
Metal Stamping & Mfg. Co., The, E. 168th St. and Waterloo Rd., Cleveland, O.
Metal & Thermit Corp., 120 Broadway, New York, N. Y.
Metalace Corp., 60 K St., South Boston, Mass.
Metallo Gasket Co., 16 Bethany St., New Brunswick, N. J.
Metropolitan Refining Co., Inc., 23-28 50th Ave., Long Island City, N. Y.
Mettler Co., Lee B., 406 S. Main St., Los Angeles, Cal.
Meyer & Bro. Co., F., 1313 S. Adams St., Peoria, Ill.
Meyer Mfg. Co., 4823 Wabash Ave., Detroit, Mich.
Michigan Pipe Co., 503 Phoenix Bldg., Bay City, Mich.
Micro Products Co., 20 N. Wacker Dr., Chicago, Ill.
Micro Switch Corp., 1 E. Spring St., Freeport, Ill.
Micro-Westco, Inc., Bettendorf Office Bldg., Bettendorf, Ia.
Middleton Mfg. & Sales Co., 125 N. First St., Minneapolis, Minn.
●Midwest Piping & Supply Co., Inc., Second and Barry St., St. Louis, Mo.
Milburn Co., Alexander, 1420 W. Baltimore St., Baltimore, Md.
Milcor Steel Co., S. 41st & Burnham Sts., Milwaukee, Wis.
Miller Electric Mfg. Co., 905 N. Meade St., Appleton, Wis.
Miller Rubber Co., Inc., 1247 S. High St., Akron, O.
Millers Falls Co., 57 Wells St., Greenfield, Mass.
Mills Novelty Co., 4110 W. Fullerton Ave., Chicago, Ill.
Milwaukee Reliance Boiler Wks., 2784 N. 32nd St., Milwaukee, Wis.
Milwaukee Valve Co., S. Burrell St. at E. Hayes Ave., Milwaukee, Wis.
Mineral Insulation Co., 103rd & Southwest Highway, Chicago Ridge, Ill.
Minfelt Insulation Co., The, 2288 Albion St., Toledo, O.
●Minneapolis-Honeywell Regulator Co., 2701 Fourth Ave., South, Minneapolis, Minn.
Misener Mfg. Co., Inc., 326 E. Washington St., Syracuse, N. Y.
Mitchell & Smith, Inc., 9469 Copeland Ave., Detroit, Mich.
Modern Engineering Co., 3411 Pine Blvd., St. Louis, Mo.
Modern Equipment Corp., Defiance, O.
Modine Mfg. Co., 17th St., Racine, Wis.
Moeller Instrument Co., 132nd St. & 89th Ave., Richmond Hill, N. Y.
Mojonnier Bros. Co., 4601 W. Ohio St., Chicago, Ill.
Molock Foundry & Machine Co., Kaukauna, Wis.
Monarch Mfg. Works, Inc., Salmon & Westmoreland Sts., Philadelphia, Pa.
Monash-Younker Co., 1315 W. Congress St., Chicago, Ill.
Monat Valve & Forge Co., Inc., 900 Bessemer Bldg., Pittsubrgh, Pa.
Moncrief Furnace Co., P. O. Box 1673, Atlanta, Ga.
Monitor Controller Co., 51 S. Gay St., Baltimore, Md.
Monmouth Products Co., 1929-41 E. 61st St., Cleveland, O.
Montag Stove & Furnace Wks., 2011 N. Columbia Blvd., Portland, Ore.
Montgomery Bros., 61 Fremont St., San Francisco, Cal.
Moore Steam Turbine Corp., Wellsville, N. Y.
Moran Flexible Steam Joint Co., 217 W. Main St., Louisville, Ky.
Morehead Mfg. Co., 4895 Grand River Ave., Detroit, Mich.
Morey & Jones, Ltd., 922 S. Hemlock St., Los Angeles, Cal.
Morris Machine Wks., 50 E. Genesee St., Baldwinsville, N. Y.
Morse Chain Co., Turner Pl., Ithaca, N. Y.
Mortell Co., J. W., 310 S. Michigan Ave., Chicago, Ill.
Motor Equipment Co., 214 W. Douglas, Wichita, Kans.
Mouat Vapor Heating Co., The, 1246-1254 W. 4th St., Cleveland, O.
Mountain States Equipment Co., 1238 Speer Blvd., Denver, Colo.
●Mueller Brass Co., Port Huron, Mich.
Mueller Co., Decatur, Ill.
Mueller Furnace Co., L. J., 2005 W. Oklahoma Ave., Milwaukee, Wis.
Mueller Steam Specialty Co., Inc., 351 W. 26th St., New York, N. Y.
Multi-Sealer Mfg. Co., 123 N. Jefferson St., Chicago, Ill.
Muncie Gear Wks., Inc., Muncie, Ind.
●Mundet Cork Corp., 65 S. 11th St., Brooklyn, N. Y.
Mundt & Sons, Charles, Jersey City, N. J.
Murdock Mfg. & Supply Co., 426-30 Plum St., Cincinnati, O.
Murray Iron Wks. Co., 1106 Washington St., Burlington, Ia.
Murray Mfg. Co., D. J., Wausau, Wis.
Mutual Chemical Co. of America, 270 Madison Ave., New York, N. Y.
Myers & Bro. Co., F. E., The, Ashland, O.
Myers Electric Co., 410 Third Ave., Pittsburgh, Pa.

N

●Nash Engineering Co., South Norwalk, Conn.
Nash Refrigeration Co., Inc., 79 Poinier St., Newark, N. J.
Nason Co., 1050 Mt. Elliott Ave., Detroit, Mich.
National Airoil Burner Co., Inc., 1284 E. Sedgley Ave., Philadelphia, Pa.
National Aluminate Corp., 6621 W. 66th Pl., Chicago, Ill.
National Brass Co., 1603 Madison Ave., Grand Rapids, Mich.
National Brass & Copper Co., Inc., Lisbon, O.
National Carbon Co., Carbon Sales Div., P. O. Box 6087, Cleveland, O.
National Engineering Products, Inc., Commerce and Savings Bldg., Washington, D. C.
National Gypsum Co., Delaware Ave., Buffalo, N. Y.
National Lead Co., 111 Broadway, New York, N. Y.
National Machine Wks., Peoples Gas Bldg., Chicago, Ill.
National Mfg. Corp., 151 Fillmore Ave., Tonawanda, N. Y.
National Metal Products Corp., 21 N. Loomis St., Chicago, Ill.
National Meter Co., 4221 First Ave., Brooklyn, N. Y.
National Pipe Bending Co., 122 River St., New Haven, Conn.
National Radiator Co., The, 221 Central Ave., Johnstown, Pa.
National Standard Air Products Co., 325 W. Huron St., Chicago, Ill.
National Steam Pump Co., 701 W. Johnson St., Upper Sandusky, O.
National Steel Corp., Grant Bldg., Pittsburgh, Pa.
National Tube Co., United States Steel Corp. Subsidiary, Frick Bldg., Pittsburgh, Pa.
National Valve & Mfg. Co., 3101 Liberty Ave., Pittsburgh, Pa.
Naugatuck Mfg. Co., Union City, Conn.
Naylor Pipe Co., 1251 E. 92nd St., Chicago, Ill.
Neemes Foundry, Inc., 216 First St., Troy, N. Y.
Nelson Co., 2604 Fourth Ave., Detroit, Mich.
Nelson Corp., Herman, 2nd St., Moline, Ill.
Nelson Mfg. Co., B. F., Corner Main & Marshall Sts., N. E., Minneapolis, Minn.
Neptune Meter Co., 50 W. 50th St., New York, N. Y.
●Nesbitt, Inc., John J., & Buckeye Blower Co., State Rd. & Rhawn St., Philadelphia, Pa.
New Albany Machine Mfg. Co., E. 10th & Water Sts., New Albany, Ind.
New Departure Div., General Motors Sales Corp., Bristol, Conn.
New Haven Copper Co., Seymour, Conn.
New Jersey Zinc Sales Co., Front & Fletcher Sts., New York, N. Y.
New York Air Valve Corp., 611-621 Broadway, New York, N. Y.
New York Blower Co., 3155 Shields Ave., Chicago, Ill.
New York Brass Foundry, 405 Broome St., New York, N. Y.
Newark Wire Cloth Co., 351 Verona Ave., Newark, N. J.
Newman Brothers, Inc., 666 W. Fourth St., Cincinnati, O.
Newman Co., Inc., 6 E. 45th St., New York, N. Y.
Newport Rolling Mill Co., Div. of The Andrews Steel Co., Ninth & Lowell Sts., Newport, Ky.
Niagara Blower Co., 6 E. 45th St., New York, N. Y.
Niagara Machine & Tool Wks., 637-697 Northland Ave., Buffalo, N. Y.
Nicholson & Co., W. H., 12 Oregon St., Wilkes-Barre, Pa.
Niles Rolling Mill Co., Niles, O.
Norge Div., Borg-Warner Corp., 670 E. Woodbridge St., Detroit, Mich.
Norgren Co., Inc., C. A., 222 Santa Fe Dr., Denver, Colo.
Norma-Hoffmann Bearings Corp., Stamford, Conn.
Norman Sheet Metal Mfg. Co., W. F., 212-236 N. Cedar St., Nevada, Mo.
Norristown Magnesia & Asbestos Co., Washington St., Norristown, Pa.
North American Mfg. Co., 2910 E. 75th, Cleveland, O.
Northern Blower Co., 6409 Barberton Ave., Cleveland, O.
Northern Equipment Co., 1945 Grove Drive, Erie, Pa.
Northern Indiana Brass Co., 935 Plum St., Elkhart, Ind.
Northern Weatherstrip Co., 367 S. First Ave., E. Duluth, Minn.
Norwin Co., E. Album St., Freeport, Ill.
Norwood Filtration Co., The, N. Maple St., Florence, Mass.
Nu-Way Corp., 2416-4th Ave., Rock Island, Ill.
Nye Tool & Machine Wks., The, 4120-30 Fullerton Ave., Chicago, Ill.

O

Oakite Products, Inc., 22 Thames St., New York, N. Y.
Oberdorfer Brass Co., M. L., 2307 Thompson Rd., Syracuse, N. Y.
O'Brien Varnish Co., South Bend, Ind.
Ohio Brass Co., N. Main St., Mansfield, O.
Ohio Electric Mfg. Co., 5906 Maurice Ave., Cleveland, O.
Ohio Injector Co., Wadsworth, O.
Ohio Pattern Works & Foundry Co., Eureka Valve Div., 2735 Colerain Ave., Cincinnati, O.
Ohio Pipe Bending & Machine Co., 3900-3910 Trent Ave., Cleveland, O.
Ohio Products Co., 16507 Lucille Ave., Cleveland, O.
Ohio Welder Co., Middlefield, O.
Ohl & Son, George A., 159 Oraton St., Newark, N. J.
Ohmlac Paint & Refining Co., 6540 S. Central Ave., Chicago, Ill.
Oil Well Supply Co., Oil City, Pa.

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Orr & Sembower, Inc., Box 817, Reading, Pa.
Osborn Co., The J. M. & L. A., 1541 E. 38th St., Cleveland, O.
Oster Mfg. Co., 2057 E. 61st Pl., Cleveland, O.
Ostlind Valve, Inc., Portland, Ore.
Otis Steel Co., 3341 Jennings Rd., Cleveland, O.
Owen Dyneto Div., U. S. L. Battery Corp., Syracuse, N. Y.
●Owens-Corning Fiberglas Corp., Nicholas Bldg., Toledo, O.
Ozo-Ray Process Corp., 400 N. Sangamon St., Chicago, Ill.

P

PS Inc., 1227-35 Wall St., Los Angeles, Cal.
Pacific Gas Radiator Co., Huntington Park, Cal.
●Pacific Lumber Co., The, 100 Bush St., San Francisco, Cal.
Pacific States Felt & Mfg. Co., Inc., 845 Howard St., San Francisco, Cal.
Pacific Steel Boiler Div., United States Radiator Corp., 1056 First National Bank Bldg., Detroit, Mich.
Page Steel & Wire, Div. of American Chain & Cable Co., Inc., Monessen, Pa.
Paine Co., 2951 W. Carroll Ave., Chicago, Ill.
Pains Fireworks Display Co., 22 Park Pl., New York, N. Y.
Palmer Co., 2501 Norwood Ave., Cincinnati (Norwood), O.
Palmer Electric Co., 20 Sproat St., Detroit, Mich.
Palmer's Mfg. Corp., Phoenix, Ariz.
Pangborn Corp., Pangborn Blvd., Hagerstown, Md.
Paragon Electric Co., 37 W. Van Buren St., Chicago, Ill.
Parker Appliance Co., 17325 Euclid Ave., Cleveland, O.
Parker-Kalon Corp., 200 Varick St., New York, N. Y.
Parkersburg Iron & Steel Co., Parkersburg, W. Va.
Parks-Cramer Co., 970 Main St., Fitchburg, Mass.
Parsons, John R., 151 E. 19th St., New York, N. Y.
Patten Co., J. V., 500 De Kalb Ave., Sycamore, Ill.
Patterson Foundry & Machine Co., East Liverpool, O.
●Patterson-Kelley Co., Inc., East Stroudsburg, Pa.
Paxtix, Inc., 308 W. Washington St., Chicago, Ill.
Payne Furnace & Supply Co., Inc., 336-338 N. Foothill Rd., Beverly Hills, Cal,
Peabody Engineering Corp., 580 Fifth Ave., New York, N. Y.
Peck, Stow & Wilcox Co., Center St., Southington, Conn.
Pecora Paint Co., 4th & Penna. R. R., Philadelphia, Pa.
Pedrick Tool & Machine Co., 3640 N. Lawrence St., Philadelphia, Pa.
Peerless of America, Inc., 515 W. 35th St., Chicago, Ill.
Peerless Electric Co., 3021 W. Market St., Warren, O.
Peerless Machine Co., 1615 Racine St., Racine, Wis.
Peerless Pump Div., Food Machinery Corp., 300 Walnut Rd., Massillon, O.
Peerless Unit Ventilation Co., Inc., 810 Union Ave., Bridgeport, Conn.
Pels & Co., Inc., Henry, 90 West St., New York, N. Y.
Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.
Penn Cooling Tower Wks., 1337 Nixon St., Pittsburgh, Pa.
Penn Electric Switch Co., Box 556, Goshen, Ind.
Penn Mfg. Corp. of Washington, Pa., 380 W. Chestnut St., P. O. Box 484, Washington, Pa.
Penn Ventilating Co., 2812 Richmond St., Philadelphia, Pa.
Pennsylvania Engineering Wks., 526 S. Jefferson St., New Castle, Pa.
Pennsylvania Forge Co., Milnor & Bleigh Sts., Philadelphia, Pa.
Pennsylvania Pump & Compressor Co., Easton, Pa.
Pennsylvania Salt Mfg. Co., 1335 Chestnut St., Philadelphia, Pa.
Perfect Circle Co., The, Hagerstown, Ind.
Perfection Grate & Stoker Co., 4 Fiske Ave., Springfield, Mass.
Perfection Refrigeration Parts Co., Harvey, Ill.
Perfex Corp. (Controls Div.), 415 W. Oklahoma Pl., Milwaukee, Wis.
Perfex Corp. (Unit Heater Div.), 415 W. Oklahoma Pl., Milwaukee, Wis.
Perham Products, Inc., 133 N. Wacker Dr., Chicago, Ill.
Perkins Machine Co., 4 Perkins Ave., Warren, Mass.
Perkins & Son, Inc., B. F., Chicopee St., Holyoke, Mass.
Permatex Co., Inc., Sheepshead Bay, N. Y.
Permutit Co., 330 W. 42nd St., New York, N. Y.
Pernot & Rich, Inc., 2546 San Fernando Rd., Los Angeles, Cal.
Peterson Freezem Mfg. & Sales Co., 2620 Charlotte Ave., Kansas City, Mo.
Petroleum Heat & Power Co., 110 Davenport St., Stamford, Conn.
Petrometer Corp., 1 Star Sq., Long Island City, N. Y.
Pfening Co., Fred D., 1075 W. 5th Ave., Columbus, O.
Phelps Dodge Copper Products Corp., British American Tube Div., 40 Wall St., New York, N. Y.
Phelps Mfg. Co., 801 Thomas St., Little Rock, Ark.
Philadelphia Gear Co., Erie Ave. & G St., Philadelphia, Pa.
Philadelphia Pipe Bending Co., 4135-65 N. Fifth St., Philadelphia, Pa.
Philadelphia & Reading Coal & Iron Co., N. E. Cor. 12th & Market Sts., Philadelphia, Pa.
Philadelphia Thermometer Co., 915 Filbert St., Philadelphia, Pa.
Philco Radio & Television Corp., 3710 N. Broad St., Philadelphia, Pa.
Phoenix Brass Fittings Corp., Colt St. & Chancellor Ave., Irvington, N. J.
Phoenix Ice Machine Co., 2711 Church St., Cleveland, O.
Pier Equipment Mfg. Co., 1440 Milton St., Benton Harbor, Mich.
Pierce Butler Radiator Corp., 701 Nichols Ave., Syracuse, N. Y.
Pierce Co., Wm. B., 41 N. Division St., Buffalo, N. Y.
Pilley Packing & Flue Brush Co., 606 S. Third St., St. Louis, Mo.
Pioneer Heat Regulator Div., Master Electric Co., The, 100 Davis Ave., Dayton, O.
Pioneer Roofing & Sheet Metal Co., 226 N. Main St., Muskogee, Okla.
Pipe Fabrication Institute, 1108 Clark Bldg., Pittsburgh, Pa.
Pittsburgh Brass Mfg. Co., 3155 Penn Ave., Pittsburgh, Pa.
Pittsburgh Equitable Meter Co., 400 N. Lexington Ave., Pittsburgh, Pa.
Pittsburgh Lectrodryer Corp., P. O. Box 1766, Pittsburgh, Pa.
Pittsburgh Pipe Coil & Bending Co., 61 Bridge St., Etna, Pa.
Pittsburgh Piping & Equipment Co., 43rd St. & A. V. R. R., Pittsburgh, Pa.
Pittsburgh Steel Co., Grant Bldg., Pittsburgh, Pa.
Pittsburgh Tube Co., Vandergrift Bldg., Pittsburgh, Pa.
Pittsburgh Valve & Fittings Corp., Barberton, O.
Pittsburgh Water Heater Co., Box 1109, Pittsburgh, Pa.
Plant Rubber & Asbestos Works, 537 Brannan St., San Francisco, Cal.
Plastergon Wall Board Co., Philadelphia Ave., Buffalo, N. Y.
Plastic Products Co., 6475 Georgia Ave., Detroit, Mich.
Pleasantaire Corp., Tower Bldg., Washington, D. C.
Plummer Spray Equipment Co., 700 Filmore St., Napoleon, O.
Plymouth Cordage Co., Court St., N. Plymouth, Mass.; Anderson Products, Inc., Cambridge, Mass., National Sales Agents.
Pomona Pump Co., 206 E. Commercial St., Pomona, Cal.
Poole Foundry & Machine Co., 1700 Union Ave., Woodberry, Baltimore, Md.
●Porter & Co., Inc., H. W., 825 Frelinghuysen Ave., Newark, N. J.
Powell Co., Wm., 2525 Spring Grove Ave., Cincinnati, O.
Power King Tool Corp., 310 E. Market St., Warsaw, Ind.
Power Piping Div., Blaw Knox Co., 829 Beaver Ave., Pittsburgh, Pa.
●Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.
Practical Instrument Co., 2717 N. Ashland Ave., Chicago, Ill.
Prat-Daniel Corp., Port Chester, N. Y.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia, Pa.
Preferred Utilities Mfg. Corp., 33 W. 60th St., New York, N. Y.
Presstite Engineering Co., 3900 Chouteau St., St. Louis, Mo.
Propellair, Inc., 1345 Lagonda Ave., Springfield, O.
Prox Co., Inc., Frank, 1201 S. First St., Terre Haute, Ind.
Public Works Supply Co., 93 Brookline St., Lynn, Mass.
Puhl & Hepper Mfg. Co., 6400 W. Florissant Ave., St. Louis, Mo.
Pure Carbonic, Inc., Lincoln Building., New York, N. Y.
Pyott Foundry & Machine Co., 328 N. Sangamon St., Chicago, Ill.
Pyrolite Products Co., Cleveland, O.
Pyrometer Instrument Co., 103 Lafayette St., New York, N. Y.

Q

Quaker City Iron Wks., Allegheny & Tulip Sts., Philadelphia, Pa.
Quimby Pump Co., Inc., 340 Thomas St., Newark, N. J.

R

R-S Products Corp., Germantown Ave., at Wayne Junction, Philadelphia, Pa.
R. U. V. Engineering Corp., 110 E. 42nd St., New York, N. Y.
Radiator Specialty Co., Charlotte, N. C.
Rafter Machine Co., 259 Stephens St., Belleville, N. J.
Raisler Sprinkler Co., 129 Amsterdam Ave., New York, N. Y.
Ramsay Chain Co., Inc., 1029 Broadway, Albany, N. Y.
Ramtite Co., The, 2563 W. 18th St., Chicago, Ill.
Ranco, Inc., 601 W. 5th Ave., Columbus, O.
●Randall Graphite Products Corp., 609 W. Lake St., Chicago, Ill.
Ravena Iron Co., Ravena, N. Y.
Rawlplug Co., Inc., The, 98 Lafayette St., New York, N. Y.
Ray Oil Burner Co., 401-499 Bernal Ave., San Francisco, Cal.
●Reading-Pratt & Cady Div., American Chain & Cable Co., Inc., 929 Connecticut Ave., Bridgeport, Conn.
Red Jacket Mfg. Co., Davenport, Ia.
Red Spot Electric Co., 4302 S. Tacoma Way, Tacoma, Wash.
Reed Unit-Fans, Inc., 811 St. Charles St., New Orleans, La.
Reeves Steel & Mfg. Co., Dover, O.
Refinite Corp., Refinite Bldg., Omaha, Neb.
Refractory & Insulation Corp., 381 Fourth Ave., New York, N. Y.
Refrigeration Appliances, Inc., 917-923 W. Lake St., Chicago, Ill.
Refrigeration Economics Co., Inc., 1232 Second St., N. E., Canton, O.
Rega Mfg. Co., 79 Mt. Hope Ave., Rochester, N. Y.
Register & Grille Mfg. Co., Inc., 70 Berry St., Brooklyn, N. Y.
Reichert Float & Mfg. Co., 2238 Smead Ave., Toledo, O.
Reif-Rexoil, Inc., 37-43 Carroll St., Buffalo, N. Y.
Reilly Tar & Chemical Corp., 1615 Merchants Bank Bldg., Indianapolis, Ind.
Reliable Perforating Co., 2047 N. Wood St., Chicago, Ill.
Reliance Automatic Lighting Co., 1929 Mead St., Racine, Wis.
Reliance Electric & Engineering Co., Ivanhoe Rd., Cleveland, O.
Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland, O.
Reliance Refrigerating Machine Co., 3401 N. Kedzie Ave., Chicago, Ill.
●Rempe Co., 340 N. Sacramento Blvd., Chicago, Ill.
Rensaeller Valve Co., Ontario St., Cohoes, N. Y.

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Reps Tool, Inc., 220 Delaware Ave., Buffalo, N. Y.
Republic Flow Meters Co., 2240 Diversey Pkwy., Chicago, Ill.
Republic Rubber Div., Lee Rubber & Tire Corp., Youngstown, O.
●Republic Steel Corp., Republic Bldg., Cleveland, O.
Research Corp., Chrysler Bldg., New York, N. Y.
Research Products Corp., 1011-1015 E. Washington Ave., Madison, Wis.
Resisto Pipe & Valve Co., 262 Bridge St., East Cambridge, Mass.
Resistoflex Corp., Belleville, N. J.
Revere Copper & Brass, Inc., 230 Park Ave., New York, N. Y.
Reynolds Electric Co., 2603 W. Congress, Chicago, Ill.
Reznor Mfg. Co., Mercer, Pa.
●Rhoads & Sons, J. E., 35 N. Sixth St., Philadelphia, Pa.
Rhode Island Fittings Co., Hillsgrove, R. I.
Rhode Island Humidifier & Ventilating Co., 99 Chauncey St., Boston, Mass.
Rhodes, Inc., M. H., 30 Bartholomew St., Hartford, Conn.
Richmond Engineering Co., Inc., 7th and Hospital Sts., Richmond, Va.
Richmond Radiator Co., Gas Products Div., Uniontown, Pa.
●Ric-wiL Co., 1562 Union Trust Bldg., Cleveland, O.
Ridge Tool Co., Box 670, Elyria, O.
Riley Stoker Corp., 9 Neponset St., Worcester, Mass.
Robbins & Myers, Inc., Lagonda Ave., Springfield, O.
Roberts Tube Works, 2500 Military Ave., Detroit, Mich.
Roberts-Gordon Appliance Corp., 137 Arthur St., Buffalo, N. Y.
Roberts-Hamilton Co., 707-715 S. Third St., Minneapolis, Minn.
Robertson Co., H. H., 2000 Grant Bldg., Pittsburgh, Pa.
Rochester Mfg. Co., Rochester, N. Y.
Rock Island Register Co., 2435 Fifth Ave., Rock Island, Ill.
Rock Products Co., 150 Fourth Ave., N., Nashville, Tenn.
Rock River Machine Co., Inc., N. Main St., Janesville, Wis.
Rock Wool Products Co., P. O. Box 276, Wabash, Ind.
Rockford Brass Works, Rockford, Ill.
Rockwood Mfg. Co., 1801-2001 English Ave., Indianapolis, Ind.
Rockwood Sprinkler Co., 38 Harlow St., Worcester, Mass.
Roebling's Sons, John A., South Broad St., Trenton, N. J.
Roessing Mfg. Co., 1616 Noble St., Sharpsburg Sta., Pittsburgh, Pa.
Roller Bearing Co. of America, Whitehead Rd., Trenton, N. J.
Rome-Turney Radiator Co., Canal St., Rome, N. Y.
Roots-Connersville Blower Corp., 16th St. & Columbia Ave., Connersville, Ind.
Roper Corp., Geo. D., Blackhawk Ave., Rockford, Ill.
Rosebraugh Co., W. W., 680 S. 17th St., Salem, Ore.
Rosedale Foundry & Machine Co., Columbus & Preble Aves., N. S., Pittsburgh, Pa.
Ross Engineering Corp., J. O., 350 Madison Ave., New York, N. Y.
Ross Heater & Mfg. Co., Inc., 1407 West Ave., Buffalo, N. Y.
Ross Sprinkler Co., 34 Roberts St., Pasadena, Cal.
Ross Valve Mfg. Co., Inc., 6 Oakwood Ave., Troy, N. Y.
Rotary Mfg. Co., 5718 Long Beach Ave., Los Angeles, Cal.
Rotary Seal Co., 809 W. Madison St., Chicago, Ill.
Roxalin Flexible Lacquer Co., Inc., 800 Magnolia Ave., Elizabeth, N. J.
Royal Ventilator Co., 415 Locust St., Philadelphia, Pa.
Royersford Foundry & Machine Co., Royersford, Pa.
Ruberoid Co., 500 Fifth Ave., New York, N. Y.
Ruby Chemical Co., 74 McDowell St., Columbus, O.
Ruemelin Mfg. Co., 3860 N. Palmer St., Milwaukee, Wis.
Ruggles-Klingemann Mfg. Co., 4 Foster Ct., Salem, Mass.
Rumsey Pump Corp., Seneca Falls, N. Y.
Rupp Forge & Shear Co., 10312 Meech Ave., Cleveland, O.
Russell Co., F. C., 6535 Euclid Ave., Cleveland, O.
Russell & Co., W. A., Bridgeport, Conn.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Russell Electric Co., 348 W. Huron St., Chicago, Ill.
Russell Mfg. Co., John M., Naugatuck, Conn.
Ruud Mfg. Co., 2934 Smallman St., Pittsburgh, Pa.
Ryerson & Son, Inc., Jos. T., 2558 W. 16th St., Chicago, Ill.
Ryniker Sheet Metal Works, Inc., 122-124 N. 25th St., Billings, Mont.

S

●SKF Industries, Inc., Front St. & Erie Ave., Philadelphia, Pa.
●St. Louis Blow Pipe & Heater Co., 1954 N. 9th St., St. Louis, Mo.
St. Paul Corrugating Co., Wabash and Water Sts., St. Paul, Minn.
Sac Tool Mfg., 1907 Washington Ave., St. Louis, Mo.
Sales & Co., Murray W., 801 W. Baltimore Ave., Detroit, Mich.
Sall Mountain Co., 176 W. Adams St., Chicago, Ill.
Sampsel Time Control, Inc., Mendota, Ill.
Samson-United Corp., 1700 University Ave., Rochester, N. Y.
Sangamo Electric Co., 1301 N. 11th St., Springfield, Ill.
●Sarco Co., Inc., 183 Madison Ave., New York, N. Y.
Sauereisen Cements Co., 2308 Main St., Sharpsburg, Pa.
Saunders Sons, Inc., D., 25 Atherton St., Yonkers, N. Y.
Scaife & Sons Co., Wm. B., 26 Ann St., Oakmont, Pa.
Schade Valve Mfg. Co., 2527 N. Bodine St., Philadelphia, Pa.
Schatz Mfg. Co., Fairview, Poughkeepsie, N. Y.
Schaub Engineering Co., Fred H., 325 W. Huron St., Chicago, Ill.
Schieren Co., Chas. A., 30-38 Ferry St., New York, N. Y.
Schneible Co., Claude B., 3951 Lawrence Ave., Chicago, Ill.
Schoedinger, F. O., 322-358 Mt. Vernon Ave., Columbus, O.
Schramm, Inc., West Chester, Pa.
Schubert-Christy Corp., Box 166, Affton Station, St. Louis, Mo.
Schundler & Co., Inc., F. E., 45-15 Vernon Blvd., Long Island City, N. Y.
Schutte & Koerting Co., 12th and Thompson Sts., Philadephia, Pa.
Schwitzer-Cummins Co., Fan St., Indianapolis, Ind.
Scientific Instrument Co., 531-35 W. Larned, Detroit, Mich.
Scott-Newcomb, Inc., 1922 Pine St., St. Louis, Mo.
Scott Valve Mfg. Co., 3963 McKinley Ave., Detroit, Mich.
Scovill Mfg. Co., Waterville Div., Waterville, Conn.
Sealed Power Corp., Muskegon, Mich.
Sealkote Corp., 40 S. Clinton St., Chicago, Ill.
Seamless Co., Inc., 5-18 48th Ave., Long Island City, N. Y.
Selas Co., The, 18th St. at Indiana Ave., Philadelphia, Pa.
Semet-Solvay Engineering Corp., 40 Rector St., New York, N. Y.
Semler Co., Jannette, Pa.
Seneca Wire & Mfg. Co., Fostoria, O.
Servel, Inc., Electric Refrigeration & Air Conditioning Div., 119 Morton Ave., Evansville, Ind.
Service To Industry, Box 133, West Hartford, Conn.
Service Machine Co., 750-760 Broadway, Elizabeth, N. J.
Shafer Bearing Corp., 35 E. Wacker Dr., Chicago, Ill.
Shallcross Co., 48th and Grays Ferry Rd., Philadelphia, Pa.
Shallcross Controls, Inc., 121 N. Broadway, Milwaukee, Wis.
Shank Co., Cyrus, 625 W. Jackson Blvd., Chicago, Ill.
Sharon Steel Co., Sharon, Pa.
Shaw Co., Benjamin F., Second & Lombard Sts., Wilmington, Del.
Shaw-Kendall Engineering Co., 120-130 S. Superior St., Toledo, O.
Shaw-Perkins Mfg. Co., Oliver Bldg., Pittsburgh, Pa.
Sheer Co., H. M., Second & Hampshire Sts., Quincy, Ill.
Sheffler-Gross Co., Drexel Bldg., Philadelphia, Pa.
Sight Feed Generator Co., 14-18 N. 10th St., Richmond, Ind.
Signal Electric Mfg. Co., Menominee, Mich.
Simmons Co., Gordon H., 926 N. Cass St., Milwaukee, Wis.
Simplex Heating Specialty Co., Inc., Pettyjohn Bldg., Lynchburg, Va.
Simplex Oil Heating Corp., 21 West St., New York, N. Y.
Sims Co., 18th & Whitley Sts., Erie, Pa.
Sinker-Davis Co., 230 S. Missouri St., Indianapolis, Ind.
Skidmore Corp., St. Joseph, Mich.
Skilbeck Mfg. Co., 7432-27th Ave., Kenosha, Wis.
Skilsaw, Inc., 3310 N. Elston Ave., Chicago, Ill.
Skinner Co., M. B., South Bend, Ind.
Skinner Engine Co., 337 W. 12th St., Erie, Pa.
Skinner Irrigation Co., 1212 E. Canal St., Troy, O.
Slater Mfg. Co., 24 Water St., Wakefield, Mass.
Sly Mfg. Co., W. W., 4700 Train Ave., Cleveland, O.
Smith Co., Inc., H. B., The, 57 Main, Westfield, Mass.
Smith Heater Co., Peter, 6209 Hamilton St., Detroit, Mich.
Smith, Inc., James Campbell, 1679 Collamer Rd., Cleveland, O.
Smith, Inc., Winfield H., Eaton St., Springville, N. Y.
Smith & Kanzler, Inc., 516-534 Lidgerwood Ave., Elizabeth, N. J.
Smith Meter Co., 5743 E. Leneve St., Los Angeles, Cal.
Smith Twin Tubular Boiler Co., Inc., Cottman St., at State Rd., Philadelphia, Pa.
Smith Welding Equipment Co., 2633 S. E. Fourth St., Minneapolis, Minn.
Smolensky Valve Co., Inc., 1931 W. 47th St., Cleveland, O.
Smooth-On Mfg. Co., 568-574 Communipaw Ave., Jersey City, N. J.
Snap-On Tools Corp., Kenosha, Wis.
Solvay Sales Corp., 42 Rector St., New York, N. Y.
Somers, Inc., H. J., 6063 Wabash Ave., Detroit, Mich.
Somerville Iron Wks., Somerville, N. J.
South Bend Air Products Corp., 304 E. Colfax Ave., South Bend, Ind.
South Chester Tube Co., Front & Thurlow Sts., Chester, Pa.
Southbridge Roofing Co., Inc., Hartwell and Chapin Sts., Southbridge, Mass.
Southern States Iron Roofing Co., Stiles Ave., Savannah, Ga.
Southworth Machine Co., 30 Warren Ave., Portland, Me.
Spang Chalfant, Inc., Div. of National Supply Co., Grant Bldg., Pittsburgh, Pa.
Specialty Converters, Inc., East Braintree, Mass.
Speedway Mfg. Co., 1834 S. 52nd Ave., Chicago (Cicero), Ill.
Spence Engineering Co., Inc., 32 Grant St., Walden, N. Y.
Spencer Heater Div., Aviation Mfg. Corp., 164 Park St., Williamsport, Pa.
Spencer Thermostat Co., 43 Forest St., Attleboro, Mass.
Spencer Turbine Co., 486 New Park Ave., Hartford, Conn.
●Spoehrer-Lange Co., 3723 Commonwealth St., St. Louis, Mo.
Spray Engineering Co., 114 Central St., Somerville, Mass.
Spray-Wheel Air Conditioners, Inc., 1320 Nineteenth St., Denver, Colo.
Spraying Systems Co., 4021 W. Lake St., Chicago, Ill.
Sprayo-Flake Co., 2715 Irving Park Blvd., Chicago, Ill.
Sprout-Waldron & Co., Muncy, Pa.
Square D Co., 6060 Rivard St., Detroit, Mich.
Square D Co., 710 S. 3rd St., Milwaukee, Wis.
Squires Co., C. E., E. 40th St. & Kelley Ave., Cleveland, O.
Standard Air Conditioning, Inc., 50 W. 40th St., New York, N. Y.
Standard Asbestos Mfg. Co., 820-822 W. Lake St., Chicago, Ill.
Standard Auto-Tite Joint Co., 7501 Thomas Blvd., Pittsburgh, Pa.
Standard Engineering Wks., 289 Roosevelt Ave., Pawtucket, R. I.
Standard Galvanizing Co., 2619 W. Van Buren St., Chicago, Ill.

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Standard Lime & Stone Co., 2004 First National Bank Bldg., Baltimore, Md.
Standard Reseater Corp., 423 W. 126th St., Orange, Mass.
Standard Rolling Mills, Inc., 143 Jewel St., Brooklyn, N. Y.
Standard Stamping & Perforating Co., 3131 W. 49th Pl., Chicago, Ill.
Standard Stoker Corp., The, New Albany, Ind.
Standard Thermometer, Inc., 65 Shirley St., Boston, Mass.
Standard Tube Co., 14600 Woodward Ave., Highland Park, Mich.
Standard Union Co., 71 Gooding St., Lockport, N. Y.
Stanley Wks., 195 Lake St., New Britain, Conn.
Staples & Pfeiffer, Ltd., 528 Bryant St., San Francisco, Cal.
Star Electric Motor Co., 197 Grove St., Bloomfield, N. J.
Star Expansion Bolt Co., 147 Cedar St., New York, N. Y.
Star Mfg. Co., Inc., 530 Kinsley Ave., Providence, R. I.
Star Products Co., 130 Walnut Ave., New York, N. Y.
Star Radiator Co., 649 Ceres Ave., Los Angeles, Cal.
Starr Piano Co., Richmond, Ind.
●Staynew Filter Corp., 25 Leighton Ave., Rochester, N. Y.
Steamaire Co., Cincinnati, O.
Steel Improvement & Forge Co., 960 Addison Rd., Cleveland, O.
Steel Products Engineering Co., Columbia St. & Dakota Ave., Springfield, O.
Steel and Tubes, Div. of Republic Steel Corp., 224 E. 131st St., Cleveland, O.
Stephens-Adamson Mfg. Co., Aurora, Ill.
Sterling Electric Motors, Inc., 5401 Telegraph Rd., Los Angeles, Cal.
Sterling Engineering Co., 3738 N. Holton St., Milwaukee, Wis.
Sterling Engineering & Mfg. Corp., 117 Business St., Hyde Park, Mass.
Stewart Ice Machine Co., 1046 E. 22nd St., Los Angeles, Cal.
Stickle Steam Specialties Co., 2215 Valley Ave., Indianapolis, Ind.
Stockham Pipe Fittings Co., 4100 Tenth Ave., N., Birmingham, Ala.
Stok-A-Fire Co., 6504 Olive St., University City, Mo.
Stokermatic Co., 1415 S. State St., Salt Lake City, Utah.
Stokes Rubber Co., Jos., Taylor & Webster, Trenton, N. J.
Straight Line Foundry & Machine Corp., Direct Separator Div., The, 218 S. Geddes St., Syracuse, N. Y.
Strandwitz & Co., Inc., W. J., Jefferson and Master Sts., Camden, N. J.
Stran-Steel Div., Great Lakes Steel Corp., 607 Shelby St., Detroit, Mich. (Ecorse Plant)
●Streamline Pipe & Fittings Div., Mueller Brass Co., Port Huron, Mich.
Strong, Carlisle & Hammond Co., The, 1392 W. Third St., Cleveland, O.
Strong-Scott Mfg. Co., Taft & Kennedy Sts., N. E., Minneapolis, Minn.
Struthers-Wells-Titusville Co., Warren, Pa.
Stuart, W. W., 417 Ninth St., Des Moines, Iowa.
●Sturtevant Co., B. F., Damon St., Hyde Park, Boston, Mass.
Sturtevant Mill Co., Park and Clayton Sts., Dorchester, Boston, Mass.
Sullivan Valve & Engineering Co., 910 S. Arizona St., Butte, Mont.
Sundstrand Machine Tool Co., 2531 11th St., Rockford, Ill.
Super Radiator Corp., 320 Plymouth Bldg., Minneapolis, Minn.
Superior Sheet Steel Co., The, Division of Continental Steel Corp., Canton-Louisville Rd., Canton, O.
Superior Valve and Fittings Co., 500 37th St., Pittsburgh, Pa.
Superseal Corp., 300 Fourth Ave., New York, N. Y.
Superstat Co., 38 Walter St., Springfield, Mass.
Supreme Air Filter Co., 126 W. 21st St., New York, N. Y.
Supreme Electric Products Corp., 99 Mt. Hope Ave., Rochester, N. Y.
Supreme Heater & Ventilating Corp., 1911 N. Market St., St. Louis, Mo.
Surface Combustion Corp., 2375 Dorr St., Toledo, O.
Swaby Mfg. Co., 2330 W. Cermak Rd., Chicago, Ill.
Swaine Mfg. Co., Fred J., 1300 N. Seventh St., St. Louis, Mo.
Swartwout Co., 18511 Euclid Ave., Cleveland, O.
Swoboda, Inc., H. O., 13th St., New Brighton, Pa.

T

Taber Pump Co., 272 Elm St., Buffalo, N. Y.
Taco Heaters, Inc., 342 Madison Ave., New York, N. Y.
Tagliabue Mfg. Co., C. J., 540 Park Ave., Brooklyn, N. Y.
Tallmadge & Co., Webster, 255 N. 18th St., East Orange, N. J.
Taylor Engineering Co., Metropole Hotel, Cincinnati, O.
Taylor Forge & Pipe Wks., P. O. Box 485, Chicago, Ill.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Taylor-Hall Welding Corp., 99 Hope Ave., Worcester, Mass.
Taylor-Winfield Corp., 1052 Mahoning Ave., Warren, O.
Tecumseh Products Co., Tecumseh, Mich.
Templeton Bros., 189 Belgrade Ave., Roslindale Station, Boston, Mass.
●Tennessee Coal, Iron & Railroad Co., Brown-Marx Bldg., Birmingham, Ala.
Terry Steam Turbine Co., The, P. O. Box 1200, Hartford, Conn.
Textite Corp., 2110 Roscoe St., Chicago, Ill.
Thatcher Furnace Co., 39 St. Francis St., Newark, N. J.
Thermal Co., Inc., 1434 N. Fourth St., Milwaukee, Wis.
Therminsul Corp., 1603 Fulford St., Kalamazoo, Mich.
Thermoid Rubber Co., Whitehead Rd., Trenton, N. J.
Thermo-Mix, Inc., 129 Grand Ave., Brooklyn, N. Y.
Thompson & Co., Box 6757, Pittsburgh, Pa.
Thomson-Gibb Electric Welding Co., 161 Pleasant St., Lynn, Mass.
Thrush & Co., H. A., Peru, Ind.
Thwing-Albert Instrument Co., 3339 Lancaster Ave., Philadelphia, Pa.
Tierney Rotor Ventilator Co., 239 Fourth Ave., S., Minneapolis, Minn.
Tiffin Art Metal Co., Broad and Second Ave., Tiffin, O.
Tilco-Fin, Inc., 58 Second Ave., Brooklyn, N. Y.
Timken Roller Bearing Co., 1835 Dueber Ave., S. W., Canton, Ohio.
Timken Steel & Tube Co., Canton, O.
Tippett & Wood, Morris and Warren Sts., Phillipsburg, N. J.
Titeflex Metal Hose Co., 500 Frelinghuysen Ave., Newark, N. J.
Titusville Iron Wks. Co., S. Franklin St., Titusville, Pa.
Todd Air Conditioning Co., Inc., Bonner Springs, Kans.
Todd Combustion Equipment, Inc., 601 W. 26th St., New York, N. Y.
Toledo Pipe Threading Machine Co., 1445 Summit St., Toledo, Ohio.
Torchweld Equipment Co., Div. of National Cylinder Gas Co., 1035 W. Lake St., Chicago, Ill.
Tork Clock Co., Inc., 1 Grove St., Mt. Vernon, N. Y.
Torrey Refrigeration Products, 1000 N. Orange Dr., Los Angeles, Cal.
●Torrington Mfg. Co., 70 Franklin St., Torrington, Conn.
Trade-Wind Motor Fans, Inc., 1325 Maple Ave., Los Angeles, Cal.
Trageser Steam Copper Wks., John, 5000 Grand St., Maspeth, Long Island, N. Y.
●Trane Co., La Crosse, Wis.
Trent Co., Harold E., 618-640 N. 54th St., Philadelphia, Pa.
Trerice Co., H. O., 1420 W. Lafayette Blvd., Detroit, Mich.
Trimont Mfg. Co., 55-71 Amory St., Roxbury, Boston, Mass.
Trimount Rotary Power Co., 398 Whiting Ave., East Dedham, Mass.
Trindl, Inc., Jos. H., 2613 S. Michigan Ave., Chicago, Ill.
Triplex Mfg. Co., Peru, Ind.
Triumph Ice Machine Co., 107-109 E. Front St., Cincinnati, O.
Troy Engine & Machine Co., Troy, Pa.
Trumbull Electric Mfg. Co., Woodford Ave., Plainville, Conn.
Truscon Steel Co., 1315 Albert St., Youngstown, O.
Tryco Products, Inc., Railroad Sq., Westfield, Mass.
Tube-Turns, 224 E. Broadway, Louisville, Ky.
Turner Brass Wks., 823-47 Park Ave., Sycamore, Ill.
Tuthill Pump Co., 939 E. 95th St., Chicago, Ill.
Tuttle Air Filter Co., Inc., 1014 W. Main St., Louisville, Ky.
●Tuttle & Bailey, Inc., Corbin Ave., New Britain, Conn.
XXth Century Heating and Ventilating Co., Cor. Ira & Edison Aves., Akron, O.

U

●U. S. Air Conditioning Corp., 2101 Kennedy St., N. E., Minneapolis, Minn.
U. S. Electrical Motors, Inc., 200 E. Slauson Ave., Los Angeles, Cal.
U. S. Electrical Tool Co., 2488-2496 W. 6th St., Cincinnati, O.
U. S. Expansion Bolt Co., P. O. Box 357, State St. & P. R. R., York, Pa.
U. S. Hame Co., 135 Tonawanda St., Buffalo, N. Y.
U. S. Motors Corp., Oshkosh, Wis.
U. S. Stoneware Co., 60 E. 42nd St., New York, N. Y.
Uehling Instrument Co., 473 Getty Ave., Paterson, N. J.
Una Welding, Inc., 1615 Collamer Ave., E., Cleveland, O.
Underground Steam Construction Co., 73 Pitts St., Boston, Mass.
Unified Air Conditioner Co., Torry Bldg., Duluth, Minn.
Uniflow Mfg. Co., E. Lake Rd., Erie, Pa.
Union Asbestos & Rubber Co., 54th Ave. and 18th St., Cicero, Ill.
Union Carbide & Carbon Corp., 30 E. 42nd St., New York, N. Y.
Union Iron Wks., 1500 Cascade St., Erie, Pa.
Union Metal Wks., Inc., 80 Carter St., Chelsea, Mass.
Union Steam Pump Co., Jefferson Ave., Battle Creek, Mich.
Union Water Meter Co., 333 Hermon St., Worcester, Mass.
●Unit Heater & Cooler Co., 1002-1024 Third St., Wausau, Wis.
United Cork Companies, Central Ave., Kearney, N. J.
United Electric Controls Co., 69 A St., Boston, Mass.
United Metal Hose Co., Inc., 36-01 43rd Ave., Long Island City, N. Y.
United Motors Service Co., General Motors Bldg., Detroit, Mich.
United States Brass & Copper Co., Hyde Park, Boston, Mass.
United States Gauge Co., 44 Beaver St., New York, N. Y.
United States Gypsum Co., 300 W. Adams St., Chicago, Ill.
United States Mineral Wool Co., 9 S. Clinton St., Chicago, Ill.
United States Ozone Co. of America, Crescent St., Scottdale, Pa.
United States Pipe & Foundry Co., Burlington, N. J.
United States Radiator Corp., 1056 National Bank Bldg., Detroit, Mich.
United States Register Co., Burnham St., Battle Creek, Mich.
United States Rubber Co., 1790 Broadway, New York, N. Y.
●United States Steel Corp., 436 Seventh Ave., Pittsburgh, Pa.
United Superior Union Co., Inc., 29 Ryerson St., Brooklyn, N. Y.
Universal Air Filter Corp., Duluth, Minn.
●Universal Cooler Corp., Green & Melville Aves., Detroit, Mich.
Universal-Cyclops Steel Corp., Bridgeville, Pa.
Universal Gypsum & Lime Co., 105 W. Madison St., Chicago, Ill.

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Universal Motor Co., 323 Universal Ave., Oshkosh, Wis.
Universal Power Corp., 4300 Euclid Ave., Cleveland, O.
Uno Ventilator Co., 565 Lincoln Ave., Cliftondale, Mass.
Upson Co., Upson Point, Lockport, N. Y.
Utica Radiator Corp., 2201 Dwyer Ave., Utica, N. Y.
Utility Fan Corp., 2528 Santa Fe Ave., Los Angeles, Cal.

V

Vanderman Mfg. Co., Mansfield Ave., Willimantic, Conn.
Van Noorden Co., E., 100 Magazine St., Boston, Mass.
Vapor Car Heating Co., Inc., 80 E. Jackson Blvd., Chicago, Ill.
Vapor Specialty Co., 101 W. 42nd St., New York, N. Y.
Ventilating Products Co., 2800 Cottage Grove Ave., Chicago, Ill.
Verson Allsteel Press Co., 93rd & Kenwood Ave., Chicago, Ill.
VibraSeal Corp., 2832 E. Grand Blvd., Detroit, Mich.
Vibration Eliminator Co., 25-08 37th St., Long Island City, N. Y.
Victaulic Co. of America, 30 Rockefeller Plaza, New York, N. Y.
Victor Electric Products, Inc., 737 Reading Rd., Cincinnati, O.
Vigor-Aire Corp., 127 S. 5th St., Philadelphia, Pa.
Viking Air Conditioning Corp., 9500 Richmond Ave., Cleveland, O.
Viking Pump Co., Fourth and State Sts., Cedar Falls, Ia.
Viking Shear Co., 1063 W. 19th St., Erie, Pa.
●Vilter Mfg. Co., 2148 S. First St., Milwaukee, Wis.
Vinco Co., Inc., The, 305 E. 45th St., New York, N. Y.
Virginia Smelting Co., West Norfolk, Va.
Viscostat Co., 30 N. La Salle St., Chicago, Ill.
Vitreous Enameling & Stamping Co., 1381 Sedgwick Ave., New York, N. Y.
Vogt Machine Co., Henry, 10th & Ormsby Sts., Louisville, Ky.
Vortex Mfg. Co., 687 N. Tillamook St., Portland, Ore.
Voss Co., J. H. H., 408 Concord Ave., New York, N. Y.
Vulcan Electric Co., Lynn, Mass.
Vulcan Radiator Co., 26 Francis Ave., Hartford, Conn.

W

●Wagner Electric Corp., 6400 Plymouth Ave., St. Louis, Mo.
Wailes Dove-Hermiston Corp., 17 Battery Pl., New York, N. Y.
Waldron Corp., John, New Brunswick, N. J.
Walker & Eder, 37 W. 39th St., New York, N. Y.
Wallace Supplies Mfg. Co., 1310 Diversey Pkwy., Chicago, Ill.
Walsh-Holyoke Steam Boiler Co., Holyoke, Mass.
Walsh-Spencer Co., 420 Boylston St., Boston, Mass.
Walworth Co., 60 E. 42nd St., New York, N. Y.
Ward Foundries, Inc., J. P., Blossburgh, Pa.
●Ward Leonard Electric Co., 37 South St., Mt. Vernon, N. Y.
Ward Machinery Co., 564 W. Washington Blvd., Chicago, Ill.
Warlo Corp., 330 W. 42nd St., New York, N. Y.
Warren Electric Appliance Co., Warren Bank & Trust Co. Bldg., Warren, Pa.
Warren Foundry & Pipe Corp., 11 Broadway, New York, N. Y.
Warren Steam Pump Co., Inc., Warren, Mass.
Washburne & Co., E. G., 207 Fulton St., New York, N. Y.
Water Cooling Tower Co., 605 W. Washington Blvd., Chicago, Ill.
Water Refining Co., 1123 Barthold, Ft. Wayne, Ind.
Waterfilm Boilers, Inc., 154 Ogden Ave., Jersey City, N. J.
●Waterloo Register Co., 2520 E. 4th St., Waterloo, Ia.
Watson & McDaniel Co., 440 N. Marshall, Philadelphia, Pa.
●Watson-Stillman Co., 140 Aldene Rd., Roselle, N. J.
Watts Regulator Co., 10 Embankment St., Lawrence, Mass.
Waukesha Motor Co., Waukesha, Wis.
Way Panel Loctor Co., Wollaston, Mass.
Wayne Oil Burner Corp., 800 Glasgow Ave., Fort Wayne, Ind.
Weatherhead Co., 300 E. 131st St., Cleveland, O.
Weaver Mfg. Co., Springfield, Ill.
●Webster & Co., Warren, 17th & Federal Sts., Camden, N. J.
Webster Electric Co., Clark & DeKoven Aves., Racine, Wis.
●Webster Engineering Co., 419 W. Second St., Tulsa, Okla.
Wedge Protectors, Inc., 9522 Richmond Ave., Cleveland, O.
Weil-McLain Co., 641 W. Lake St., Chicago, Ill.
Weil Pump Co., 215-17 W. Superior St., Chicago, Ill.
Weinman Pump Co., 290 Spruce St., Columbus, O.
Weirton Steel Co., Weirton, W. Va.
Weldex, Inc., 9666 E. Jefferson St., Detroit, Mich.
Welding Apparatus Co., 4309 Ogden Ave., Chicago, Ill.
Western Blower Co., 1800 Airport Way, Seattle, Wash.
Western Engineering & Mfg. Co., 1726 E. Washington Blvd., Los Angeles, Cal.
Western Felt Wks., 4029-4117 Ogden Ave., Chicago, Ill.
Western Furnaces, Inc., 950 Commerce St., Tacoma, Wash.
Western Hanger Co., 55 New Montgomery St., San Francisco, Cal.
Western Precipitation Corp., 1016 W. 9th St., Los Angeles, Cal.
Western Silicair Products, Inc., 72 S. Alameda Ave., Burbank, Cal.
Western Wire & Iron Works, Inc., 945 W. 18th Pl., Chicago, Ill.
Western Wire Products Co., 1415-35 S. 18th St., St. Louis, Mo.
Westfalia Separator Co., 30 Orange St., Bloomfield, N. J.
●Westinghouse Electric & Mfg. Co., Bloomfield, N. J.
●Westinghouse Electric & Mfg. Co., Cleveland, O.
●Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
●Westinghouse Electric & Mfg. Co., East Springfield, Mass.
●Westinghouse Electric & Mfg. Co., Mansfield, O.
Westinghouse X-Ray Co., Inc., 21-16 43rd Ave., Long Island City, N. Y.
Weston Electrical Instrument Corp., 619 Frelinghuysen Ave., Newark, N. J.
Wheatland Tube Co., 606-608 Real Estate Trust Bldg., Philadelphia, Pa.
Wheelco Instruments Co., 1933 S. Halsted St., Chicago, Ill.
Wheeler Mfg. Co., C. H., 19th, Lehigh & Sedgley Aves., Philadelphia, Pa.
Wheeling Corrugating Co., Wheeling Steel Bldg., Wheeling, W. Va.
Wheeling Metal & Mfg. Co., Box 56, Wheeling, W. Va.
Wheeling Steel Corp., Wheeling Steel Corp. Bldg., Wheeling, W. Va.
White Flo-Matic Corp., 30 Elm St., Hoosick Falls, N. Y.
White Mfg. Co., 2362 University Ave., St. Paul, Minn.
Whitehead Metal Products Co. of New York, Inc., 303 W. 10th St., New York, N. Y.
White-Rodgers Electric Co., 1209 Cass Ave., St. Louis, Mo.
Whiting Corp., Harvey, Ill.
Whitlock Coil Pipe Co., 100 South St., Hartford, Conn.
Whitney Chain & Mfg. Co., The, Bartholomew Ave., Hartford, Conn.
Whitney Mfg. Co., W. A., 636 Race St., Rockford, Ill.
●Whitney Metal Tool Co., 110 Forbes St., Rockford, Ill.
Wickes Boiler Co., 502 N. Water St., Saginaw, Mich.
Wickwire Spencer Steel Co., 500 Fifth Ave., New York, N. Y.
Wiedemann Machine Co., 1815 Sedgley Ave., Philadelphia, Pa.
●Wiegand Co., Edwin L., 7610 Thomas Blvd., Pittsburgh, Pa.
Wilcolator Co., 17 Nevada St., Newark, N. J.
Wilhelm Co., A., 3rd and Bern Sts., Reading, Pa.
Will-Burt Co., The, Orrville, O.
●Williams & Co., J. H., 225 Lafayette St., New York, N. Y.
Williams & Son, I. B., Dover, N. H.
Williams Gauge Co., 1620 Pennsylvania Ave., N. S., Pittsburgh, Pa.
Williams, Inc., F. C., 22667 Michigan Ave., Dearborn, Mich.
Williams Oil-O-Matic Heating Corp., 1201 East Bell, Bloomington, Ill.
Williams Valve Co., D. T., Spring Grove Ave. & Township St., Cincinnati, O.
Williamson Heater Co., 337 W. Fifth St., Cincinnati, O.
Willis Mfg. Co., Inc., 156 N. Academy St., Galesburg, Ill.
Wills Gasket Ltd., New Bedford, Mass.
Willson Products, Inc., 348 Thorn St., Reading, Pa.
Will-Weld Mfg. Co., Inc., 1501 Jackson St., Omaha, Nebr.
Wilson & Co., 4100 S. Ashland Ave., Chicago, Ill.
Wilson Co., H. A., The, 105 Chestnut St., Newark, N. J.
●Wilson, Inc., Grant, 4115 W. Taylor St., Chicago, Ill.
Wilson Welder & Metals Co., Inc., 60 E. 42nd St., New York, N. Y.
●Wing Mfg. Co., L. J., 14th St. & 7th Ave., New York, N. Y.
Wiss & Sons Co., J., 33 Littleton Ave., Newark, N. J.
Wittenmeier Machinery Co., 850-860 N. Spaulding Ave., Chicago, Ill.
Wodack Electric Tool Corp., 4644 W. Huron St., Chicago, Ill.
Wolff & Munier, Inc., 222 E. 41st St., New York, N. Y.
Wolverine Blower Works, 412 Prospect Ave., Grand Rapids, Mich.
Wolverine Tube Co., 1455 Central Ave., Detroit, Mich.
Wood Conversion Co., 1981 First National Bank Bldg., St. Paul, Minn.
Wood's Sons Co., T. B., 1275 Fifth Ave., Chambersburg, Pa.
Worthington-Gamon Meter Co., Harrison, N. J.
●Worthington Pump & Machinery Corp., Harrison, N. J.
●Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.
Wright-Austin Co., 315 W. Woodbridge St., Detroit, Mich.
Wyckoff & Son Co., A., 100 Home St., Elmira, N. Y.

X

X Laboratories, Inc., 25 W. 45th St., New York, N. Y.
X L Refrigerating Co., 1834 W. 59th St., Chicago, Ill.
X-Pando Corp., 4315 Thirty-Sixth St., Long Island City, N. Y.

Y

Yardley Screen & Weather Strip Co., 138 Parsons Ave., Columbus, O.
●Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.
Yates-American Machine Co., Beloit, Wis.
Yeomans Bros. Co., 1433 N. Dayton St., Chicago, Ill.
Yoder Co., The, 5500 Walworth Ave., Cleveland, O.
York Corrugating Co., Adams St. & W. M. R. R., York, Pa.
●York Ice Machinery Corp., Roosevelt Ave., York, Pa.
York Oil Burner Co., Inc., P. R. R. & Jessup Pl., York, Pa.
Yost Mfg. Co., Meadville, Pa.
Young & Bertke Co., 1004-1014 Hulbert Ave., Cincinnati, O.
●Young Radiator Co., 709 Mead St., Racine, Wis.
Young Regulator Co., 4500 Euclid Ave., Cleveland, O.
●Youngstown Sheet & Tube Co., 602 Stambaugh Bldg., Youngstown, O.

Z

Zapon-Brevolite Div., Atlas Powder Co., North Chicago, Ill.
Zeh & Hahnemann Co., 182-200 Vanderpool St., Newark, N. J.
Zenith Electric Co., 607 S. Dearborn St., Chicago, Ill.
Zink Co., John, 4401 S. Peoria St., Tulsa, Okla.
Zobell Electric Motor Corp., 96 South Ave., Garwood, N. J.
Zonolite Co., The, 5905 Second Blvd., Detroit, Mich.

● Advertisement in this issue. See Index to Advertisers, page 208.

Thanks.

Mr. Jones, but Actually this Kind of Service is *Routine* at CLARAGE

AMERICAN TUBE BENDING CO. INC.

Manufacturers of MANIFOLDS AND BENT TUBE PRODUCTS FOR AUTOMOBILE, AEROPLANE & MARINE MOTORS

5 LAWRENCE STREET
NEW HAVEN, CONN.

March 21, 1940

The Clarage Fan Company
Kalamazoo,
Michigan

Gentlemen:-

I would like to take this opportunity to compliment your company on the service you recently rendered us in silencing a Clarage fan operating in our plant.

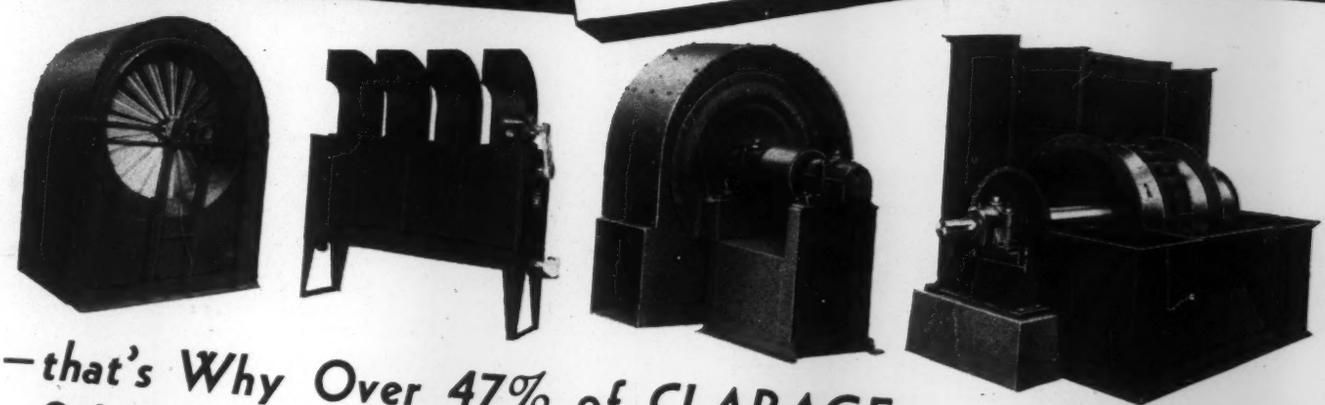
We wrote you on March 5, asking to have your representative see us, and shortly thereafter your Mr. A. L. Otis from Hartford made a call. After investigating the severe conditions under which your fan is used, he made some simple changes and left suggestions with us as to how to complete the work. As a result, we were able to rectify a very annoying situation with practically no expense.

Service of this nature undoubtedly builds good will for your company, and we should be very remiss did we not recognize it as such.

Very truly yours,

AMERICAN TUBE BENDING COMPANY INC.

Henry B. Jones, Jr.
President



—that's Why Over 47% of CLARAGE Sales is *Repeat* Business

When you buy Clarage Fan Equipment, our responsibility DOES NOT END when shipment is made. Witness the unsolicited letter above — a routine Clarage service wherever the customer needs on-the-job attention.

With factory-trained representatives—*fan engineering experts* — in all principal cities, this Company MAKES SURE of efficient, satisfactory air handling and conditioning installations, regardless of how unusual or stiff the requirements.

It's a matter of the RIGHT equipment plus TECHNICAL EXPERIENCE. *Clarage has both, as any trial order will convince you!*

COMPLETE AIR CONDITIONING
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COOLING
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•
MECHANICAL DRAFT
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FANS and BLOWERS for INDUSTRIAL NEEDS

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SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES